THE NEW
PRACTICAL NAVIGATOR;
BEING A
Complete Epitome
OF
NAVIGATION:
TO WHICH ARE ADDED,
ALL THE
TABLES REQUISITE
FOR DETERMINING THE LATITUDE AND LONGITUDE AT SEA:
CONTAINING,
THE DIFFERENT KINDS OF SAILING,
AND NECESSARY CORRECTIONS FOR LEE-WAY, VARIATION, &c.
EXEMPLIFIED
IN A JOURNAL AT SEA:
TOGETHER WITH

All neceffary Inftructions for determining the Latitude by DOUBLE ALTITUDES of the Sun, by the Moon, the Planets, and fixed Stars; and for afcertaining the LONGITUDE by the LUNAR OBSERVATIONS, and other Methods.

The Manner of finding and knowing the Planets and fixed Stars, by Calculation and Planifpheres.

The Art of Surveying Sea-Coafts and Harbours.

An Abftract of Practical Seamanfhip, fhewing the Method of Working a Ship in all difficult Cafes at Sea.

The Manner of exercifing Ship's Companies for War, defcribing the Exercife of the great Guns, and the requifite Manœuvres for attacking or defending a Ship:

The Method of recovering Ships in different Situations of Diftrefs, and keeping them from a Lee-fhore, with the beft Means of faving Perfons from Wrecks; and the Procefs of recovering drowned People, recommended by the Royal Humane Society; with a Variety of Articles *not to be found in any other Book of this Kind.*

THE WHOLE ILLUSTRATED WITH ENGRAVINGS,
And rendered eafy to the moft common Capacity.
The TABLES in this BOOK have been examined by three Perfons; and, it is trufted, are the moft correct extant.
So that this BOOK will be found fully fufficient either for the Teacher or for Practice at Sea.

THE SEVENTEENTH EDITION.
GREATLY ENLARGED AND IMPROVED,
BY
JOHN HAMILTON MOORE,
TEACHER OF NAVIGATION,
HYDROGRAPHER, SEA-BOOK, INSTRUMENT, AND CHART-SELLER.

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TO THE

Right Hon. GEORGE JOHN EARL SPENCER,
VISCOUNT ALTHORP,

AND

MASTER OF THE TRINITY-HOUSE.

THIS

NEW AND MUCH-IMPROVED EDITION

OF

THE PRACTICAL NAVIGATOR,

IS RESPECTFULLY DEDICATED,

By his Lordſhip's much-obliged,

And very humble Servant,

JOHN HAMILTON MOORE.

MAY 1ſt, 1807.

An Account of the Arrangement and Improvements in this Edition.

THE favourable reception which this Work has met with, emboldens me to present before the Public the present Edition; in which, I trust, I have introduced such improvements as will continue to me the favour which I have so long had the happiness to enjoy. In my former Editions I had digested the several Articles into a natural and simple order, and endeavoured to show how every thing might be deduced from the first and most simple principles of the Mathematics; in which, I trust, I had so far succeeded, as to render it easy to the most common capacity. How beneficial a work of this kind must be to Learners cannot be doubted, when we reflect, that by being thus acquainted with the true principles of things, they will retain better what they have learned, and be enabled to make much greater progress in the art, than could otherwise possibly take place. Indeed, upon a careful perusal of the Work, I found the plan I had pursued, so far as regards the parts of Navigation usually taught and practised at sea, could not be amended in the bulk, though some improvements might be made in particular parts. It particularly occurred to me, that I had invariably found young Gentlemen, who attended me for a private examination, previous to their passing a public one, deficient in working an observation in all the variety of situations which may take place. In this Work I have accordingly elucidated this important article, by giving a Rule for every different situation, in which the observer can possibly find himself in respect of the Sun; illustrating each with a projection on the Plane of the Meridian.

There is introduced into this Edition, a Table for the near calculating the Time of High Water, with the assistance of the Nautical Almanack.

I pass over many others of smaller note in the first part of the Book, such as partial Amendments of the Style, &c. in haste to give an account of the Arrangements and Additions in the latter part of this Work, which is for the most part New.

Previous to the year 1767, when the first Nautical Almanack was published, the practice of finding the Longitude at Sea was universally by account. The mode of ascertaining it by taking the Moon's distance from the Sun, or a fixed Star, commonly called the Lunar Observations, was attended with difficulties insurmountable to most Mariners. By the unremitting assiduity of the Astronomer Royal, to whose labours the Nautical Art is much indebted for its present high state of improvement; and by the Rewards held out by Parliament, and the consequent improvements in instruments for measuring the Angular Distance, what before was considered as nearly an impossibility, is now come into almost general practice. Proud of contributing my quota towards the facilitating this laudable purpose, so highly conducive to the commercial interests of this powerful Empire, I have endeavoured

deavoured to render this part of the Nautical Art as ſimple and plain as the nature of the ſubject will admit.

To the Deſcription of HADLEY'S QUADRANT is added the Deſcription and Uſe of HADLEY'S SEXTANT, with an Account of the new Mode of dividing the Nonius, ſo that the Diſtance can be read off to fifteen ſeconds. The Method of adjuſting the Sextant and Teleſcope is fully enlarged upon, together with the uſe of this Inſtrument, in obſerving the angular diſtance.

PARALLAX and REFRACTION are next defined, and illuſtrated with a Plate. The Method of applying the Corrections for Parallax and Refraction to the obſerved Diſtance, in order to reduce it to the true, is next given.

It being frequently complained to me by ſeamen, that it is next to impoſſible to find and know the Stars from which the Moon's diſtance is computed in the Nautical Almanack, I have, to remedy this defect, ſubjoined to this Work two plans of the Stars, one on the Plane of the Equator, the other on the Plane of the Meridian ; a deſcription of the projection and uſe of theſe Plans is given at large in the Work, together with ſome PRACTICAL DIRECTIONS for knowing the Stars.

Next in order is the Method of finding the TRUE TIME, in order to regulate the going of the Watch. The Lunar Obſervations follow, arranged in a new, clear, and perſpicuous manner. The Examination of a YOUNG SEA OFFICER, being an Abſtract of practical Seamanſhip, has been examined by two profeſſional men, and large additions made.

We have alſo added, what we conceive will be an acceptable article in the preſent times of hoſtility,—*The Method of exerciſing private Ships' Companies for War.* In this article, the forms of two Quarter Bills are given, with the Exerciſe of the great Guns, according to the preſent practice, and ſome approved manœuvres in attacking and defending a ſingle ſhip. Two additional Tables will alſo be found, one exhibiting the Proportion of Powder for Sea-Guns, the other the Number of Shot contained in Grapes of different Sizes.

A variety of Methods of relieving Ships in Diſtreſs; the beſt Means of ſaving people from Wrecks; and the Proceſs recommended by the Royal Humane Society for recovering drowned Perſons, will alſo be found.

To the Tables a ſolicitous attention has been paid. The Tables of Difference of Latitude and Departure for Points and Degrees, have been re-calculated with the greateſt care. The Tables of Logarithms of Numbers, and of Artificial Sines, Tangents, and Secants, have been carefully compared with the third edition of Hodgſon's Tables, printed in the year 1738 ; with Gardner's third edition of Sherwin's, printed in the year 1742 ; and with Dr. Hutton's laſt edition, by three perſons ; ſo that I truſt the errors, if any, are few.

The Tables which follow have undergone a ſimilar examination. To the Tables of the Sun's Declination, a moſt ſcrupulous attention has been paid. The Table of Latitudes and Longitudes of Places is corrected by the lateſt ſurveys and obſervations, and great additions made.

Table XIII. For reducing the Sun's Declination to any given Meridian, and to any time under that Meridian, in the firſt page of which

which you have the Proportional Parts of the Daily Difference of the Sun's Declination to every Minute and every fix Seconds, anfwering to every five Minutes of Time, and to every Degree and fifteen Miles of Longitude. The fecond and third page contain the fame proportional Parts to every hour, and to every fifteen Degrees of Longitude.

To the Table XVI. For turning Degrees and Minutes into Time, and the contrary, two columns are added on the right fide, for turning Minutes and Seconds (of an hour) into Longitude, and the reverfe.

Table XVIII. contains the Decimal of every Minute in twelve Hours, being of ready ufe for finding the Proportion of the fmall Difference (in twelve Hours) of the Moon's Parallax and Semi-diameter, by taking out the number from the Table anfwering to the Time when the obfervation was taken, and multiply the differences therewith from the product of each, cut off four figures from the right hand, the left hand figures are the Anfwers (if no Fraction remains) which muft be additive or fubtractive, according as they are increafing or decreafing.

The proportional Part of the Daily Difference of the Sun or Star's right Afcenfion is found by taking out the number, anfwering to half the time required, and multiply the difference therewith, from the product, cut off four figures from the right hand, the remaining figures are the anfwer. Thus you avoid working by the the Rule of Three.

In the precepts for finding the Longitude by Lunar Obfervation, page 238, you are told to make ufe of the Log Sine of 30 degrees*, half the fum of the apparent Altitudes, and half the apparent Diftance.

This Edition has been carefully examined, improved, and corrected by my friend Captain Joseph Dessiou, whofe abilities as a Navigator, Mathematician, and Draughtfman, cannot be doubted. Therefore I may prefume to fay this is the moft correct Edition that has been prefented to the Public's notice.

* The Log Sine of 30 degrees is equal to the Natural Sine of half the Radius; and, according to Euclid, Axiom 6, Book I. what things are each of them half of the same quantity, are equal among themselves.

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CONTENTS.

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For

DIRECTIONS TO THE BINDER FOR PLACING THE ENGRAVINGS.

OF FRACTIONS.

[It sometimes happens that Persons, though well acquainted with common Arithmetic, yet know very little of Fractions; but as most of the Instruments and Tables used in Navigation are decimally divided, and the Tables calculated to Tenths, &c. it becomes necessary they should be acquainted with Decimal Arithmetic; the following short Abstract of which may be found useful to the Learner.]

A FRACTION is a part of any thing; as one foot, one yard, one mile, one hour, one degree, &c.

A vulgar, or common Fraction, consists of two parts, the Numerator and the Denominator. The Denominator shews how many parts the quantity is divided into. The Numerator shews how many of those parts remain, and is always placed over the Denominator, with a line drawn between them.

A Fraction is what remains after division has been made, the remainder being the Numerator, and the divisor the Denominator; as 14 divided by 4, the quotient is 3, and 2 remains for a Numerator of a Fraction, of which 4, the divisor, is the Denominator, and is thus expressed $\frac{2}{4}$, or two fourths.

Suppose 12 inches is to be divided by 5; the number of times 5 contained in 12 is 2, and 2 remains, which remainder is the Numerator, and 5 the Denominator of the Fraction remaining, which is always a proper Fraction, thus, $\frac{2}{5}$; wherefore $\frac{1}{2}$, $\frac{3}{4}$, $\frac{2}{3}$, $\frac{4}{5}$, $\frac{9}{12}$, $\frac{5}{16}$, shews that these numbers were their respective remainders, after such divisions were made, and are read thus: one-half, three-fourths, two-thirds, four-fifths, nine-twelfths, and five-sixteenths.

A Decimal Fraction is a part of an unit, or one, supposed to be divided into 10, 100, 1000, 10,000, &c. equal parts. If the unit is divided into ten parts, and each of those parts into ten more equal parts, we obtain the foundation of Decimal Fractions.

In Vulgar Fractions the Numerator is set over the Denominator; but in Decimal Fractions the Numerator is distinguished by a comma, or point, placed before it, thus: ,5 ,75 ,125 is read thus, $\frac{5}{10}$, $\frac{75}{100}$, $\frac{125}{1000}$, that is, the first figure is 5-tenths, the second 75-hundredths, and the third 125-thousandth parts of unity, or one.

As whole Numbers increase their value in tenfold proportion from the right hand to the left, so Decimals decrease in the same proportion from the left hand towards the right: thus, ,5 ,05 ,005; or thus, $\frac{5}{10}$, $\frac{5}{100}$, $\frac{5}{1000}$.

To reduce a Vulgar Fraction to a Decimal.

RULE.—Add cyphers to the Numerator, and divide by the Denominator.

EXAMPLE

EXAMPLE I.

Reduce $\frac{1}{4}$ of a foot to a Decimal.

```
4)1,00(25
  8
  --
  20
  20
  --
   .
```

EXAMPLE II.

Reduce $\frac{3}{4}$ of a degree to a Decimal.

```
4)3,00(,75
  28
  --
  20
  20
  --
   .
```

EXAMPLE III.

Reduce $\frac{1}{2}$ an hour to a Decimal.

```
2)1,0(,5
  10
  --
   .
```

EXAMPLE IV.

Reduce $\frac{1}{3}$ of an hour to a Decimal.

```
3)1,00000(,33333
  9
  --
  10
   9
  --
  10
   9
  --
  10
   9
  --
  10
   9
  --
   1
```

EXAMPLE V.

Reduce $\frac{2}{3}$ of a degree to a Decimal.

```
3)2,00000(666666
  18
  --
  20
  18
  --
  20
  18
  --
  20
  18
  --
  20
  18
  --
   2
```

To find the value of a Decimal in the different denominations of the fame quantity.

RULE.—Multiply the Decimal by the parts of the integer, feparating to the right hand as many Decimals as are in the multiplicand; and the figures to the left hand will be the parts of the integer required.

EXAMPLE I.

What is the proper quantity of ,25 of a foot?

```
        ,25
         12
        ---
Anfwer, 3,00 inches
```

EXAMPLE II.

What is the proper quantity of ,5 of an hour?

```
        ,5
        60
        ---
Anfwer, 30,0 minutes.
```

EXAMPLE III.

What is the proper quantity of ,75 of a degree?

,75
60

Anfwer, 45,00 minutes.

EXAMPLE IV.

What is the proper quantity of ,333 of an hour?

,333
60

Anfwer, 19,980 minutes.

EXAMPLE V.

What is the proper quantity of ,666 of a degree?

,666
60

Anfwer, 39,960 minutes.

EXAMPLE VI.

What is the proper quantity of ,2236 of a degree?

,2236
60

Minutes, 13,4160
60

Seconds, 24,9600 Anfwer.

Hence the parts of an integer, whether of coins, weights, or meafures, may be reduced to a Decimal, by bringing the parts of an integer into its loweft terms for a dividend, and the integer into the fame terms for a divifor; the quotient will be the decimal parts of the integer, the value of which may be found by multiplying it by the component parts of the integer, and feparating the number of decimal places towards the right hand, as above.

Addition of Decimals.

Addition of Decimals is performed exactly as in whole numbers, only obferving to place the figures of the like denomination under each other, fo that the points which feparate the whole numbers from the Decimals ftand in a line under each other; and as many Decimal places muft be cut off from the product, as there are in the greateft number to be added.

EXAMPLES.

Fathoms.	Yards.	Feet.
Add 78,8	66,71	3720,45
34,56	148,9	25,0036
46,77	32,722	4179,802
32,53	7,81	3,6284
154,27	40,27	
81,4	38,5	Sum 7928,8840
Sum 428,33	Sum 334,912	

	Degree.	Miles or Minutes.
Add 15836,071	6,5	6,4
20,09	3,25	3,95
34,07	Sum 9,75	Sum 10,35
583,27008		
Sum 16473,50108		

Subtraction of Decimals.

Subtraction of Decimals is performed as that of whole numbers alfo, only taking care to place units with the feparating point directly under each other.

EXAMPLE

EXAMPLES.

	Degrees.		Minutes.
From............	9,75		10,35
Take............	6,5		6,4
Remainder	3,25	Remainder	3,95

Multiplication of Decimals.

Multiplication of Decimals is performed likewiſe as that of whole numbers, and as many places as there are in both the Multiplicand and Multiplier muſt be cut off towards the right hand of the product, and the numbers ſtanding on the left hand of the point will be whole numbers, and thoſe on the right hand will be Decimals.

EXAMPLE I.

Multiply 27,75 by 7,5.

```
 27,75
   7,5
 -----
 13875
19425
 -----
Anſwer 208,125
```

EXAMPLE II.

Multiply 39,25 by 6,5.

```
 39,25
   6,5
 -----
 19625
23550
 -----
Anſwer 255,125
```

EXAMPLE III.

Multiply 25,96 by 9,25

```
     9,25
    -----
    12980
   5192
  23364
  -------
Anſwer 240,1300
```

EXAMPLE IV.

Multiply 45,96 by 20,36

```
    20,36
    -----
    27576
   13788
  91920
  --------
  935,7456
```

Diviſion of Decimals.

This Rule is alſo worked as in whole numbers; the only difficulty is in valuing the quotient, which is done by the following Rules:

1ſt. If the Diviſor and Dividend have the ſame number of Decimal parts, the quotient will be a whole number.

2d. If the Dividend has not ſo many places of Decimals as are in the Diviſor, then ſo many cyphers muſt be annexed to the Dividend as will make them equal, and the quotient will be a whole number.

3d. But when the diviſion is done, if the quotient has not ſo many figures as it ſhould have places of Decimals, then ſo many cyphers muſt be affixed as there are places wanting.

EXAMPLE I.

Divide 208,125 by 7,5.

```
7,5)208,125(27,75
    150
    ---
     581
     525
     ---
      562
      525
      ---
      375
      375
```

EXAMPLE II.

Divide 255,125 by 6,5.

```
6,5)255,125(39,25
    195
    ---
     601
     585
     ---
      162
      130
      ---
      325
      325
```

Rule of Three in Decimals.

Rule of Three in Decimals is worked in the ſame manner as common Arithmetic, that is, by multiplying the ſecond and third terms together, and dividing by the firſt, the quotient will be the anſwer; and of the ſame denomination as the ſecond term.

EXAMPLE.

Yards.	Shillings.	Yards.
If 3,5	6,75	12,25

```
 12,25
  6,75
 -----
  6125
  8575
 7350
 -----
3,5)82,6875(23,625
    78              12
    --              --
    126          7,500
    105              4
    ---          -----
    ,218         2,000
    210          -----
    ---
     ,,87
      70
      --
      175
      175
      ---
       ,,
```

Anſ. 1l. 3s. $7\frac{1}{2}$d.

In like manner may any other be worked, whether in coins, weights, meaſure, or time, by reducing the parts of the integer into Decimals, and then find the value as above.

The three laſt Rules may be worked by Logarithms, which will be ſhewn when we come to treat of their uſe.

GEOMETRICAL

GEOMETRICAL DEFINITIONS.

GEOMETRY is the Science which treats of the Deſcription, Properties, and Relations of Magnitudes in general; of which there are three Kinds or Species, viz. a Line, which has only Length without either Breadth or Thickneſs; a Superficies, comprehended by Length and Breadth; and a Solid, which has Length, Breadth, and Thickneſs.

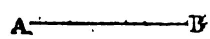
I.

A point conſidered mathematically, is incapable of being divided, and therefore hath no parts, or it is the ſmalleſt part of ſpace that can be aſſigned, and may be conceived ſo infinitely ſmall, as to be void of length, breadth, or thickneſs, being always denoted by a dot, as at A.

A.

II.

A right line is the neareſt diſtance between two points, which limits its length, without any ſuppoſed breadth, or thickneſs, as AB; it may be ſuppoſed to be the flowing of a point.

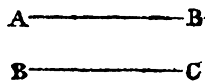


III.

A plane ſuperficies is that which lies evenly between its extreme points, reſembling a ſmooth table, or poliſhed glaſs; bounded by lines having length and breadth: but is conceived to have no depth or thickneſs, and may be conceived to be generated by the flowing of a right line.

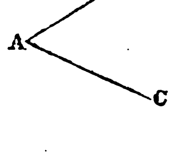
IV.

Parallel lines are ſuch as are equally diſtant in all their parts, which extended infinitely on the ſame plane would never meet, as the lines AB, BC.



V.

A plane angle is the inclination or meeting of two right lines in one point; the point where they meet is called the angular point, and the lines AB and AC are called ſides or legs; it is generally expreſſed by three letters, the middle one always denotes the angular point, as A, and the other two the legs or ſides that include it, as AB or AC.

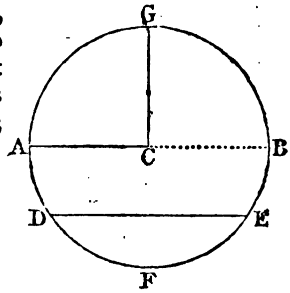


VI.

A circle is a plane figure, bounded by an uniform curve line; it is ordinarily defcribed by a right line, taken with a pair of compaffes; one point thereof being fixed, whilft the other is turned round to the place where the motion firft began; the fixed point is called the centre, and the line defcribed by the other point is called the circumference.

VII.

The radius of a circle, or femidiameter, is a right line drawn from the centre to the circumference, as AC; or it is that line which is taken between the points of the compaffes to defcribe the circle; and is half its diameter AB.



VIII.

An arch of a circle is any part or portion of the circumference, as DFE.

IX.

A chord of a circle is the fubtence of an arch, or it is a right line joining the ends of an arch; it divides the circle into two unequal parts, called fegments, and is a chord to them both, as DE is the chord of the arches DFE and DGE.

X.

A femicircle, or half a circle, is a figure contained under the diameter, as AGB or AFB.

XI.

A quadrant is half a femicircle, or one fourth part of the whole circle; as the figure CAG.

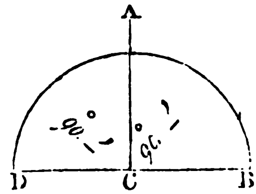
NOTE. All circles, whether great or fmall, are actually, or fuppofed to have, their circumference divided into 360 equal parts, called degrees, and each degree into 60 equal parts, called minutes, and each minute into 60 equal parts, called feconds, and fo on into thirds, fourths, &c.

All angles are meafured by an arch of a circle, defcribed round their angular points, with the chord of 60 degrees, taken from the line of chords on the plane fcale, and are eftimated greater or lefs according to the number of degrees contained betwixt their legs; and though legs be ma'e longer or fhorter, ftill the angle between them continues the fame.

XII. A right

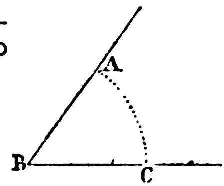
XII.

A right line is ſaid to be PERPENDICULAR to another line, when it falls upon it ſo as to make the angles on each ſide of it equal, ſuch as the figure ABCD, where the angle ACD is equal to the angle ACB, each a quadrant, or right angle, containing 90 degrees.



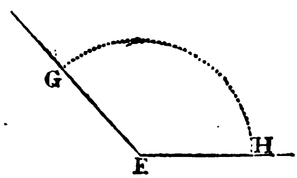
XIII.

An ACUTE ANGLE is leſs than a right angle, and is that which contains leſs than 90 degrees, as ABC.



XIV.

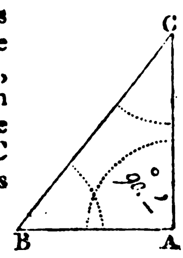
An OBTUSE ANGLE is greater than a right angle, and is that which contains more than 90 degrees, as the angle GEH.



The feweſt number of right lines that can include a ſpace are three, which form a figure called a triangle, or three-cornered figure, and conſiſts of ſix parts, viz. three ſides and three angles; it is diſtinguiſhed into three ſorts, viz. a right-angled triangle, an obtuſe-angled triangle, and an acute-angled triangle.

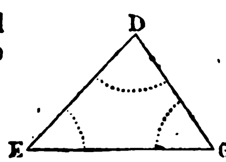
XV.

A RIGHT-ANGLED TRIANGLE has one of its angles right, or containing 90 degrees; the ſide oppoſite the right angle is called the hypothenuſe, and the other two ſides are called legs; that which ſtands upright is called the perpendicular, and the other the baſe: thus BC is the hypothenuſe, AC the perpendicular, and AB the baſe; the angles oppoſite the two legs are both acute.



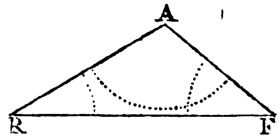
XVI.

An ACUTE-ANGLED TRIANGLE has all its angles acute, or none of them equal to 90 degrees, as DEG.



XVII.

An Obtuse-angled Triangle has one of its angles obtuse, or greater than 90 degrees, as RAF, the other two angles are acute, or less than 90 degrees, as in the triangle RAF.



Note. All triangles that are not right-angled, whether they are acute or obtuse, are in general terms called oblique-angled triangles, without any other distinction. The sum of the two acute angles of a right-angled triangle make 90°, the sum of all the angles of any triangle 180°. If from 180 you take the sum of the other two angles, the remaining angle will be found; but in a right-angled triangle, if from 90 you subtract the one angle, the other angle will remain.

MARKS or CHARACTERS.

$+$ Signifies *more*, or the Sign of Addition; it shews that whatever numbers or quantity follow this Sign must be added to those that go before it, thus $9+8$, that is 9 added to 8. Or, $A+B$ implies that the quantities represented by A and B are added.

$-$ Signifies *less*, and is used as the Sign of Subtraction; it denotes that the number following it must be subtracted from those going before it, as $7-5$, or 5 subtracted from 7.

$\times$ The Sign of Multiplication, and shews that the numbers placed before and after are to be multiplied, thus 7×9, that is 7 multiplied by 9, which makes 63, and $7\times8\times2$ which makes 112.

$\div$ This mark stands for Division, and signifies that the number that stands before it is to be divided by the number following it, as $72\div12$ shews that 72 is to be divided by 12. Or thus, $\frac{72}{12}$

$=$ The Sign of Equality: it shews that the numbers or quantities placed before it are equal to those following it. thus, $8\times12=96$. Or 8 multiplied by 12 is equal to 96, and $\overline{7+2}\times4=36$.

$: :: :$ Proportion, and is read thus, $7 : 14 :: 10 : 20$, that is, as 7 is to 14, so is 10 to 20. Or, $A : B :: C : D$, that is, as A is to B, so is C to D.

° Signifies Degrees, thus 45° shew the number 45 degrees.
′ Signifies Minutes, thus 24′ or minutes.
″ Signifies Seconds, thus 44″ or 44 seconds.
S Stands for Sine.
Sec.——for Secant.
Tan.——Tangent.

Each of these last with Co. before them, signifies the complement, as Co-sine, Co-tangent, Co-secant.

$\angle$ Signifies Angle.
$\angle$d Angled, with an s at top Angles $\angle^s$
$\triangle$ Signifies Triangle, or $\triangle^s$.
Z Is frequently put to signify the sum of any two lines or numbers.
Y Signifies the difference.

GEOME-

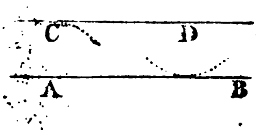
GEOMETRICAL PROBLEMS,

USEFUL IN NAVIGATION.

A PROBLEM *is a practical* PROPOSITION, *in which Something is proposed to be done or effected.*

PROBLEM I.

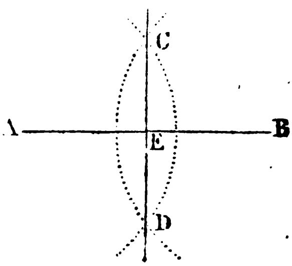
To draw a Right Line parallel to a given Right Line, to any given Distance, as at the Point D.



WITH a pair of compasses take the nearest distance between the point D and the given right line AB, with that distance set one foot of the compasses any where on the line AB, as at A, and draw the arch C, from the point D draw a line so as just to touch the arch C, and it is done; for the line CD will be parallel to the line AB, and at the distance of the point given D, as was required.

PROBLEM II.

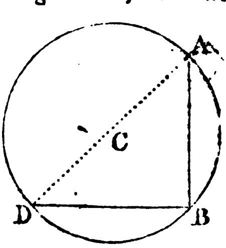
To bisect or divide a given Line into two equal Parts.



With any distance in your compasses greater than half the line AB, with one foot in B, describe an arch with the same distance, and one foot in A, describe an arch that will cut the former arch in C and D; through C and D draw a line, and that will cut AB in E; and the line AB will be divided at the point E into two equal parts.

PROBLEM III.

To erect a Perpendicular on the End of a given Right Line, as DB.

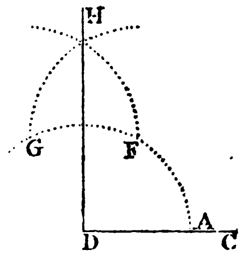


With any distance in your compasses, as from B to C, with one foot in C, describe the circle BDA, so that it may just touch the end of the given line at B; from whence the circle cuts the line as at D, draw a line through the points D and C, to cut the circle in A; from A draw the line AB, which will be the perpendicular required.

Or thus,

With

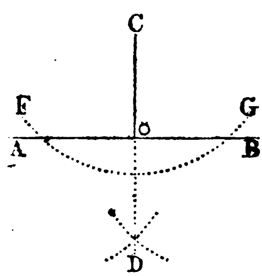
With any convenient diſtance in your compaſſes, as from D to A, with one foot in D, deſcribe the arch AFG, ſet off the ſame diſtance from A to F, and from F to G; upon F and G deſcribe two arches interſecting one another in H; draw a line from H to D, and it is done; for HD will be the perpendicular required.



PROBLEM IV.

From a given Point, as C, *to let fall a Perpendicular on a given Right Line* A B.

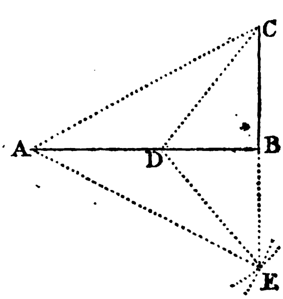
With one foot in C, deſcribe an arch to cut the given line AB in F and G, with one foot in G deſcribe an arch, and with the ſame diſtance, and one foot in F, deſcribe an arch to cut the former in D, from C to D draw a line, and it is done; for CD will be the perpendicular required.



PROBLEM V.

From a given Point to let fall a Perpendicular in a given Line, when the ſaid Perpendicular is to fall ſo near the End of the given Line that it cannot be done as above, as at the Edge of a Sheet of Paper, &c.

Let C be the point from which the perpendicular is to be let fall on the line AB, from any point in the line AB, as at A; with the diſtance AC, deſcribe an arch E, chuſe any other point in the line AB, as D, and with the diſtance DC deſcribe another arch interſecting the former in E, join CE, and it is done; for CB will be the perpendicular required.

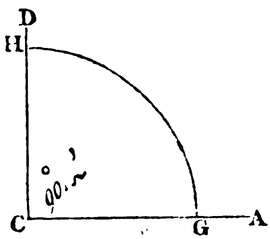


PROBLEM

PROBLEM VI.

To make Plane Angles, and first a Right Angle, containing 90 *Degrees.*

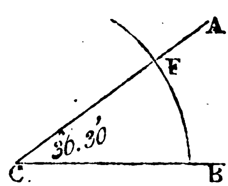
Draw the line CA on C, erect a perpendicular CD, and it is done; for the angle DCA is an angle of 90°. Or thus, On the point C, with the chord of 60°, describe an arch GH, and set off thereon from G to H, the distance of the chord of 90°, and from C through H draw CHD, which will form the angle DCA of 90° required.



PROBLEM VII.

To make an Acute Angle equal to any number of Degrees. Suppose 36° 30′.

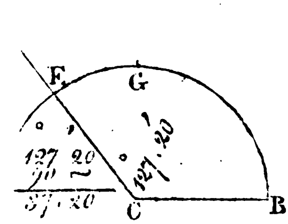
Draw the line BC, with the chord of 60° or radius, in your compasses, and one foot on C, draw the arch FB, on which set off 36° 30′, or 36½, from B to F, through F and the centre C, draw the right line AC, and it is done; for the angle ACB will be an angle of 36° 30′ as was required.



PROBLEM VIII.

To make an Obtuse Angle, that shall contain 127° 20′.

Draw CB, take the chord of 60° in your compasses, and with one foot on C describe an arch; now, as we can take off only 90°, set off 90° from B to G, and from G to E set off the excess above 90°, which is 37° 20′, or 37⅓; draw the line CE, and it is done; for the angle ECB will be an angle of 127° 20′.

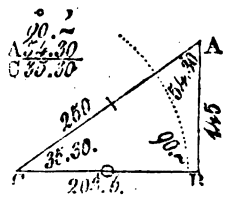


PROBLEM IX.

The Angles and Hypothenuſe of a Right-angled Triangle given, to find either of the Legs.

Given the hypothenuſe 250 leagues, the angle oppoſite the baſe 54° 30′, conſequently the other angle 35° 30′; the baſe and perpendicular are required.

Draw the line CB, and at C make an angle equal to 35° 30′ by drawing the line CA, take 250 from any convenient ſcale of equal parts, and ſet it off from C to A, from A let fall the perpendicular AB, to cut the line CB, and it is done; for AB meaſured on the ſame ſcale gives 145, and CB 203.6 leagues.



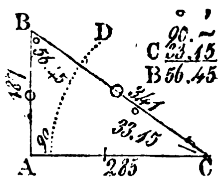
NOTE. The two acute angles of a right-angled triangle make 90 degrees.

PROBLEM X.

The Angles and one Leg of a Right-angled Triangle being given, to find the Hypothenuſe and the other Leg.

The angle ACB 33° 15′, the leg AC 285 miles, to find the hypothenuſe and the other leg AB.

Draw the baſe AC, lay off on it 285 from your ſcale of equal parts, from A to C; on A erect the perpendicular AB: with the chord of 60° ſweep the arch AD, and on it ſet off $33°\frac{1}{4}$, from your line of chords from A to D, through D and C, draw the right line BC, then BC will meaſure 341 nearly, and BA 187 nearly, on the ſame ſcale of equal parts that AC was taken from.

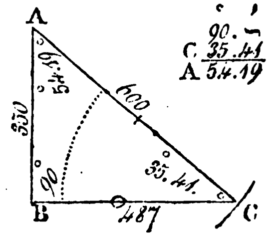


PROBLEM XI.

The Hypothenuſe and one Leg given, to find the Angles and the other Leg.

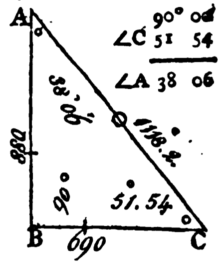
The leg AB 350, the hypothenuſe 600 given, to find the angles, and leg BC.

Draw the baſe CB, on B erect the perpendicular AB, on which ſet off 350 from B to A, on the point A with an opening of 600. Draw an arch to cut the line BC, in the point C draw AC, and it is done; for the angle ACB will meaſure 35° 41′ on the line of chords, and BC will meaſure 487 nearly, on the ſame ſcale of equal parts before uſed.



PROBLEM XII.

The Legs given, to find the Angles and the Hypothenuse.



The leg AB 880 and BC 690 given, to find the angles A and C, and the hypothenuse AC.

Draw the base BC; on B erect the perpendicular AB, make BC equal to 690, and AB equal to 880; join AC, and it is done; for the angle C being measured as before, will be found as per figure, and the hypothenuse will measure 1118,2.

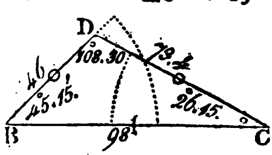
PROBLEM XIII.

Two Angles and one Side of an Oblique-angled Triangle given; to find either of the other Legs.

∠B 45° 15′
∠D 108 30

153 45
180 00

∠C 26 15



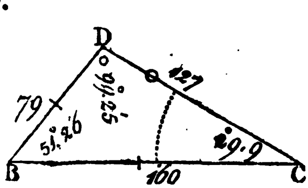
The angle BDC 180° 30′, and CBD 45° 15′, and consequently the angle BCD 26° 15′, and the leg BC 98 given, to find the sides CD and BD.

Draw the line BC, which make equal to 98, on the point B describe an angle of 45° 15′, then add 45° 15′ to 108° 30′ and the sum 153° 45′ taken from 180, the remainder is the angle BCD=26° 15′; from the point C describe an arch with the chord of 60, and set off 26° 15′, and it is done; for the side BD will be 46 nearly, and DC 73,4, as was required.

PROBLEM XIV.

Two Sides and an Angle opposite to one of them given; to find the other Angle and the third Side.

The side BC 160, and BD 79, and the angle C 29°, 9′ given, to find the angle D, and the side CD.



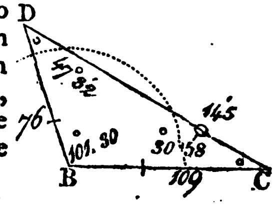
Draw the line BC equal to 160, on C make the angle DCB equal to 29° 9′, take 79 in your compasses, and with one foot on B, lay the other upon the line CD, draw the line BD, and it is done; for the angle D will be 99° 25′, the angle B 51° 26′, and the side DC 127 nearly.

PROBLEM XV.

Two Sides and their contained Angle given, to find either of the other Angles, and the third Side.

The ſide BC 109, BD 76, and angle CBD 101° 30′ given, to find the angles BDC or BCD, and the ſide CD.

Draw the line BC, which make equal to 109; on B deſcribe an arch, on which ſet off from BC towards D 101° 30′, then draw the line BD equal to 76, join DC, and it is done; for the angle BDC will be 47° 32′, the angle BCD 30° 58′, and the ſide DC will be 145, as was required.



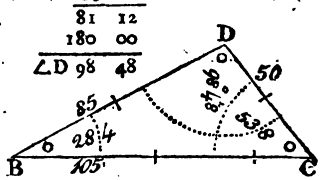
PROBLEM XVI.

Three Sides given, to find the Angles.

The ſides BC 105, BD 85, and CD 50 miles given, to find the angles BDC, BCD, and CBD.

∠B	28°	04′
∠C	53	08
	81	12
	180	00
∠D	98	48

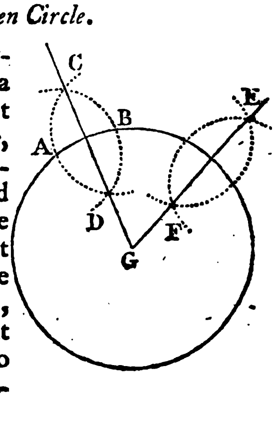
Draw the line BC equal to 105, take CD equal to 50 in your compaſſes, and with one foot in C, deſcribe an arch as at D, then take BD 85 in your compaſſes, and with one foot in B cut the former arch in D, join BD and DC, and it is done; for the angle B being meaſured, will be found 28° 4′, the angle C 53° 8′, which being added together is 81° 12′, their ſum ſubtracted from 180′, leaves angle D 98° 48′, as was required.



PROBLEM XVII.

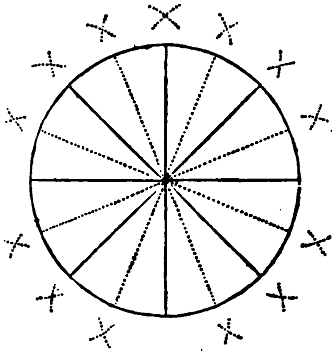
To find the Centre to a given Circle.

With any radius, and one foot in the circumference as at A, deſcribe an arch of a circle, as CBD, then removing the foot from A to whence it cuts the given circle, as at B, on B deſcribe another arch, cutting or croſſing the former, as CAD, and through the points of interſection draw the right line CD, which will give one right line paſſing through the centre; in like manner may another right line be drawn, as EFG, which will croſs the firſt right line at the centre required, for any two diameters will always cut or croſs one another in the central point.



PROBLEM XVIII.

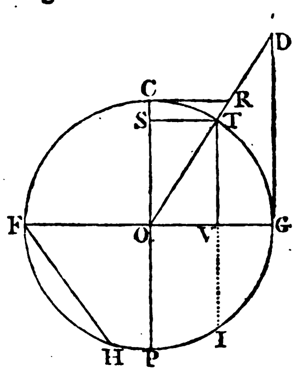
To divide a Circle into any Number of equal even Parts, as 4, 16, 32.



First draw the diameter through the centre, which will divide it into two equal parts; bisect the diameter with another right line perpendicular thereto, and the circle will be divided into four equal parts or quadrants; bisect each of these quadrants again by right lines drawn through the centre, and it will be divided into eight equal parts, and so may you continue on your bisections any number of times, that is 4, 8, 16, 32, &c. doubling the number of even parts.

This Problem is useful in constructing the Mariner's Compass.

I. A chord or subtense of an arch, is a right line that divides the circle into two unequal parts, and is a chord to them both, as FH, TI.



II. A right sine of an arch is a line drawn from the end or termination of an arch, perpendicular to the radius, or is half the chord of twice the arch, so that TV is the sine of the arch TG, and of the arch TF, the sum of which arches together make 180°, or a semi-circle.

III. The versed sine of an arch is part of the diameter intercepted between the right sine and the arch, as VG.

IV. The tangent of an arch is a line drawn perpendicular to the end of the radius, or diameter, just touching the arch, as DG.

V. The secant of an arch is a right line drawn from the centre through the circumference, meeting the end of the tangent line to the same arch, as OD is the secant of the arch TG, to which DG is tangent; also OR is the secant of the arch CT, to which CR is a tangent.

NOTE. Sines, Tangents, Secants, are said to be the measure of so many degrees as the arch contains parts of 360, so that radius being the sine of a quadrant, or a fourth part of the circumference, contains 90 degrees; thus the radius is always equal to the sine of 90°, as is also the tangent of 45°, and the chord of 60°.

PROJECTION
OF THE LINES OF
SINES, TANGENTS, AND SECANTS,
ON THE PLANE SCALE.

1ft. WITH the radius you intend for your fcale, defcribe a femi-circle ADBC, and upon the centre C raife the perpendicular CD, (which will divide the femi-circle into two quadrants, AD, BD), continue CD directly to S, and upon B raife the perpendicular BT, then draw the right lines BD and AD.

2dly. Divide the quadrant BD into 9 equal parts, then will each of thefe be 10 degrees. Again, you may fubdivide each of thefe parts into fingle degrees; and thefe again, if your radius admits it, into minutes, or fome aliquot parts of a degree greater than minutes.

3dly. Set one foot of the compaffes in B, and transfer each of the divifions in the quadrant BD to the right line BD, then is BD a line of chords.

4thly. From the points 10, 20, 30, &c. in the quadrant BD, draw right lines parallel to CD, till they cut the radius CB, then is the line CB divided into a line of fines, which muft be numbered from C towards B.

5thly. If the fame line of right fines be numbered from B towards C, it will become a line of verfed fines, which may be continued to 180°, if the fame divifions be transferred on the fame line on the other fide of the centre C.

6thly. From the centre C, through the feveral divifions in the quadrant BD, draw right lines till they cut the tangent BT, fo will the line BT become a line of tangents.

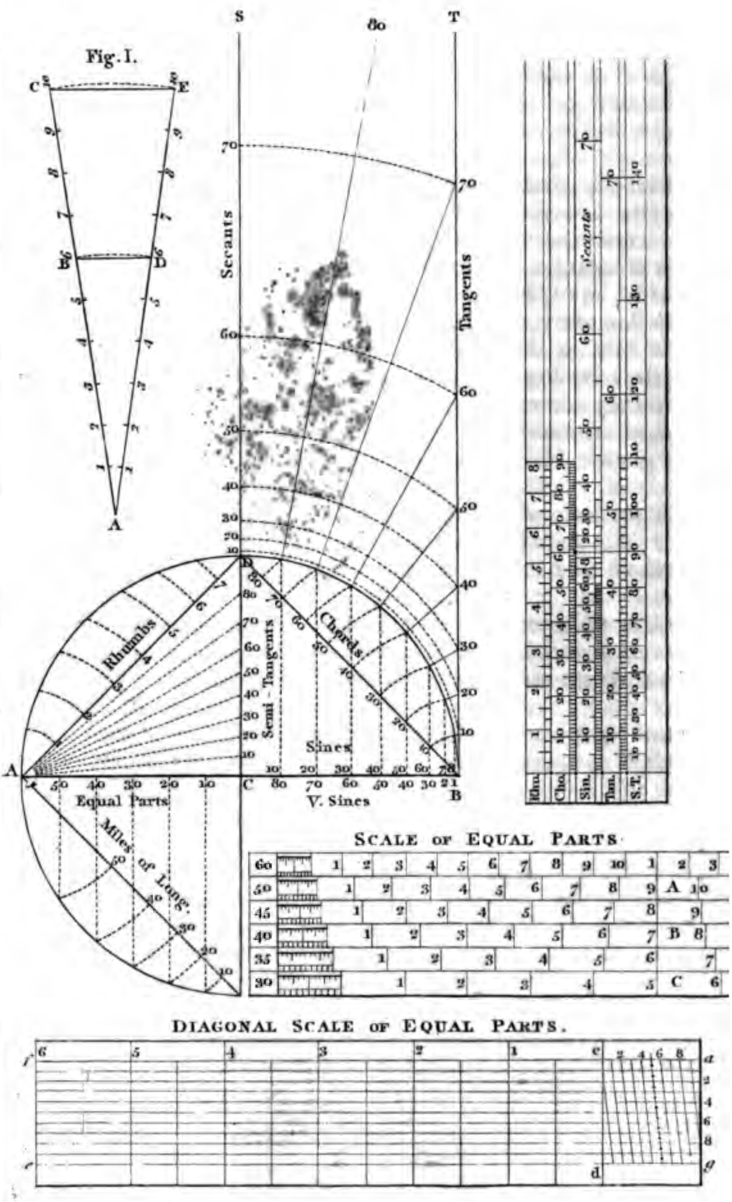
7thly. Setting one foot of the compaffes in C, extend the other to the feveral divifions 10, 20, 30, &c. on the tangent line BT, and transfer thefe extents feverally into the right line CS, then will the line CS be a line of fecants.

8thly. Right lines drawn from A to the feveral divifions, 10, 20, 30, &c. in the quadrant BD, will divide the radius CD into a line of femi-tangents.

9thly. Divide the quadrant AD into eight equal parts, and from A transfer thefe divifions feverally into the line AD, then is AD a line of rhumbs, each divifion anfwering to 11° 15′ upon the line of chords.

The

PROJECTION OF THE PLAIN SCALES &c.



The uſe of this line is for protracting and meaſuring of angles, according to the common diviſion of the Mariner's Compaſs. If the radius AC be divided into 100, or 1000, &c. equal parts, and the lengths of the ſeveral ſines, tangents, and ſecants, correſponding to the ſeveral arches of the quadrant be meaſured thereby, and theſe numbers be ſet down in a table, each in its proper column, you will, by theſe means, have a triangular canon of numbers, by which the ſeveral caſes in Trigonometry may be ſolved, the right lines, graduated as above, being placed ſeverally upon a ruler, form the inſtrument called the Plane Scale; by which the lines and angles of all triangles may be meaſured. All right lines, as the ſides of plane triangles, &c. when they are conſidered ſimply as ſuch, without having any relation to a circle, are meaſured by ſcales of equal parts, one of which is ſubdivided equally into 10, and this ſerves as a common diviſion to all the reſt. In moſt ſcales an inch is taken for a common meaſure to determine their largeneſs and number of parts; what an inch is divided into is generally ſet at the end of the ſcale, as in the ſcales A, B, and C; the numbers 10, 20, 30, 45, ſhew that ſo many parts of the ſcales A, B, C, are contained in an inch. By any ſcale of equal parts, divided as above, any number leſs than 100 may be readily taken; but, if the number ſhould conſiſt of three places of figures, the value of the third figure can only be gueſſed at; wherefore, in theſe ſcales, it is better to uſe ſuch a ſcale as D, called a diagonal ſcale, by which any number of three figures may be exactly found.

Having prepared a ruler of convenient breadth for your ſcale, (which may be an inch, more or leſs), firſt, near the edges thereof, draw two right lines, *af*, *eg*, parallel to each other; then divide one of theſe lines, as *af*, into equal parts, according to the largeneſs you intend your ſcale; and through each of theſe diviſions draw perpendicular right lines as far as the line c g; next divide the breadth into 10 equal parts, and through each of theſe diviſions draw right lines parallel to the former a f and c g; again divide the length a, b, c, d, each into 10 equal parts, and from the point to the firſt diviſion in the line d q, draw a right line; then parallel to that line, draw right lines through all the other diviſions, and the ſcale is done.

Beſides the lines already mentioned, there is another on the plane ſcale, marked ML, which is joined to a line of chords; and ſhews how many miles, eaſting or weſting, make a degree of longitude in every latitude; theſe ſeveral lines are generally put on one ſide of a ruler, two feet long; and on the other ſide are laid down a ſcale of the logarithms of the ſines, tangents, and numbers, which is commonly called Gunter's Scale, and as it is of general uſe, it requires a particular deſcription.

DESCRIPTION

DESCRIPTION AND USE OF GUNTER's SCALE.

WHILE the Reader is perufing the following, it is proper he fhould have a GUNTER's SCALE before him.

Gunter's Scale hath fet upon it thefe eight lines following:

1ft. Sine rhumbs, marked (SR) is a line which contains the logarithms of the natural fine of every point and quarter point of the Mariner's Compafs, figured from the left hand towards the right, with 1, 2, 3, 4, 5, 6, 7, to 8, where is a brafs pin, and where it can be done, into halves and quarters.

2d. Tangent rhumbs, marked (TR) alfo correfponds to the logarithm of the tangent of every point of the compafs, and is figured 1, 2, 3, 4, where there is a pin, and from thence towards the left hand with 5, 6, 7.

3d. The line of numbers marked (Num.) contains the logarithms of the numbers, and is figured thus; near the left hand it begins at 1, and towards the right hand is 2, 3, 4, 5, 6, 7, 8, 9; and then 1, at which is a brafs centre pin, going ftill on 2, 3, 4, 5, 6, 7, 8, 9, and 10 at the end, where there is another brafs pin; (as this line is generally much ufed, it requires a larger defcription.) The firft one may be counted for 1, or 10, or 100, or 1000, and then the next 2 is accordingly 2, or 20, or 200, or 2000, &c. Again, the firft 1 may be reckoned 1 tenth, or 1 hundredth, or 1 thoufandth part, &c. then the next is 2 tenth, or 2 hundredth, or 2 thoufandth parts, &c. fo that if the firft one be efteemed 1, the middle 1 is then 10, and 2 to its right is 20, 3 is 30, 4 is 40, and 10 at the end is 100; again, if the firft 1 is 10, the next 2 is 20, 3 is 30, fo on, making the middle 1 now 100, the next 2 is 200, 3 is 300, 4 is 400, and 10 at the end is now 1000. In like manner, if the firft 1 be efteemed 1 tenth part, the next 2 is 2 tenth parts, and the middle 1 is 1, and the next 2 is 2, and 10 at the end is now 10. Again, if the firft 1 be counted 1 hundredth part, the next is 2 hundredth parts, the middle one is now 10 hundredth parts, or 1 tenth part, and the next 2 is 2 tenth parts, and 10 at the end is now but one whole number or integer.

As the figures are increafed or diminifhed in their value, fo, in like manner, muft all the intermediate ftrokes, or fubdivifions, be increafed or diminifhed; that is, if the firft 1 at the left hand be counted 1, then 2 (on the right hand of it) is 2, and each fubdivifion between them now is 1 tenth part, and fo all the way to the middle 1, which now is 10, the next 2 is 20, now the longer ftrokes between 1 and 2 are to be counted from 1, thus; 11, 12,

(where

(where is a braſs pin), then 13, 14, 15, ſometimes a longer ſtroke than the reſt, then 16, 17, 18, 19, 20, at the figure 2; and all the ſhorter ſtrokes between them longer, are now each to be counted for 1 tenth part from the middle one to the next 2, now 20, from whence the longer ſtrokes between the figures are units, thus 21, 22, 23, &c. to 3, which now is 30, and the ſhorter ſtrokes each between them, now is the tenth part of an integer; from 3, each ſhort ſtroke or diviſion, is 1 tenth part of an unit. Again, if 1 at the left hand be 10, the figures between it and the middle 1 are common tens; and the ſubdiviſions between each figure are units; from the middle 1 to 10 at the end; each figure is ſo many hundredths; and between theſe figures each longer diviſion is 10; from the middle 1 to 2, each leſs diviſion is 2 units; and, from 2 to the end, each ſhorter diviſion is 5 units. From this deſcription it will be eaſy to find the diviſions repreſenting any given number, thus: Suppoſe the point repreſenting the number 12 was required: Take the diviſion at the figure 1, in the middle, for the firſt figure of 12; then, for the ſecond figure, count 2 tenths, or longer ſtrokes to the right hand, and this laſt is the point repreſenting 12, where is the braſs pin.

Again, Suppoſe the number 22 were required, the firſt figure being 2, I take the diviſion to the figure 2, and for the 2d figure 2, count 2 tenths onwards, and that is the point repreſenting 22.

Again, Suppoſe 1728 were required; for the firſt figure 1, I take the middle 1, for the ſecond figure 7, count onwards as before, and that is 1700; then for the third 2 count 2 tenths from the laſt, and it repreſents 1720; laſtly, for the 4th figure 8, eſtimate 8 parts out of 10 of the next ſmaller diviſion, or a little leſs than 10, this point, laſt found, repreſents 1728.

Required the point, repreſenting the number 435: from the 4 in the 2d interval count towards 5 on the right, three of the larger diviſions, and one of the ſmaller, and that will be the diviſion expreſſing 435, and the like of other numbers, which by a little practice is readily done.

All fractions found in this line muſt be decimals; and if they are not, they muſt be reduced into decimals, which is eaſily done by extending the compaſſes from the denominator to the numerator; that extent laid upon 1 in the middle will reach to the decimal required.

Example. Required the decimal fraction equal to $\frac{3}{4}$, extend from 4 to 3, that extent will reach from 1 on the middle to 75, towards the left hand; the like may be obſerved of any other vulgar fraction.

MULTIPLICATION is performed on this line, by extending from 1 to the multiplier; that extent will reach from the multiplicand to the product.

Suppoſe, for example, it was required to find the product of 16 multiplied by 4, extend from 1 to 4, that extent will reach from 16 to 64, the product required.

DIVISION

Division being the reverse of Multiplication, therefore extend from the divisor to unity, that extent will reach from the dividend to the quotient.

Suppose 64 to be divided by 4, extend from 4 to 1, that extent will reach from 64 to 16, the quotient.

N. B. This extent in Division is to be taken backwards from the dividend to the quotient, but in multiplication it is taken forward from the multiplicand to the product, they being contrary to one another.

Proportion, or the Rule of Three, being performed by Multiplication and Division, therefore extend from the first term to the second, that extent will reach from the third term to the fourth.

Example. If the diameter of a circle be 7 inches, and the circumference 22, what is the circumference of another circle, the diameter of which is 14 inches?

Extend from 7 to 22, that extent will reach from 14 to 44 the same way.

In like manner may any other proportion, of any denomination, be worked, which makes this line of general use, particularly in measuring Superfices and Solids, which is done by extending from 1 to the breadth, that extent will reach from the length to the superficial content.

Example. Suppose a plank or board 15 inches broad, and 27 feet long, the content of which is required.

Extend from 1 to 1 foot 3 inches, $=1.25$, that extent will reach from 27 feet to 33,75 feet, the superficial content. Or extend from 12 inches to 15, &c.

The solid content of any bale, box, chest, &c. is found by extending from 1 to the breadth, that extent will reach from the depth to a fourth number, and the extent from 1 to that fourth number, will reach from the length to the solid content.

Example 1st. What is the content of a square pillar, whose length is 21 feet 9 inches, and breadth 1 foot 3 inches?

The extent from 1 to 1,25, will reach from 1,25 to 1,56, the content of 1 foot in length; again, the extent from 1 to 1,50, will reach from the length 21,75 to 33,98 or 34, the solid content in feet.

Example 2d. Suppose a square piece of timber, 1,25 feet broad, 56 deep, and 36 long, be given to find the content.

Extend from 1 to 1,25, that extent will reach from ,56 to ,7, then extend from 1 to ,7, that extent will reach from 36 to 25,2 the solid content. In like manner may the contents of any bales, &c. be found, which, divided by 40, will give the tonnage.

3dly. The line of sines, marked (Sin.) begins at the left hand, and is figured thus: 1, 2, 3, 4, 5, &c. to 10; then 20, 30, 40, &c. to 90, ending at the right hand, where is a brass centre pin, here, and in all lines under it, are called degrees.

4thly. The line of versed sines, marked (V.S.) begins at the right hand, against 90° on the sines, and from thence figured towards the left hand, thus: 10, 20, 30, 40, &c. ending at the left hand—about 169°;

169°; each of the ſubdiviſions, from 10 to 30, are 2 degrees, and from thence to 90, it is ſingle degrees, and from thence to the end, each degree is divided into 15 minutes.

5thly. The line of tangents, marked (Tang.) begins at the left hand, as do the ſines; from thence it is figured to the right hand, thus: 1, 2, 3, &c. to 10, and ſo on, 20, 30, 40, and 45, at the right hand, where is a little braſs pin, juſt under and even with 90° in the ſines; from thence back again it is figured 50, 60, 70, 80, &c. to 89, ending at the left hand where it began at 1 degree. The ſubdiviſions of this line are the ſame as thoſe of the ſines.

6thly. The line of the meridional parts, marked (Mer.) begins at the right hand, and is numbered thus: 10, 20, 30, to the left hand, where it ends at 87 degrees. This line, with the line of equal parts, marked (EP) under it, are uſed together, and only in Mercator's ſailing. The uppermoſt line contains the degree of the meridians, or latitude, in a Mercator's chart; and the lower is the equator, and contains the degrees of longitude.

ON THE DESCRIPTION AND USE OF THE SECTOR.

THIS inſtrument conſiſts of two legs or rulers, repreſenting the radius of a circle, moveable round a joint in the centre; on each face are drawn ſeveral lines or ſcales from the centre to almoſt the end of the legs, and are drawn on both legs, that every ſcale may have its fellow, and are called ſectoral lines. There are other lines drawn parallel to the edges of the legs, and muſt be uſed with the ſector quite open, the uſe of which is explained in the deſcription of the Gunter ſcale. On one face are two lines of chords to 60 degrees, marked Cho. or C. two ſcales of equal parts to 10, marked Lin. or L. two lines of ſecants to 75 degrees, marked Sec. or S. two lines of poligons marked pol. Upon the other face the ſectoral lines are two ſcales of ſines to 90 degrees, marked Sin. or S. two lines of tangents to 45 degrees, marked Tan. or T. two lines of upper tangents to ſupply the defect of the former, extending from 45 degrees to 75 degrees, and marked t. ſeveral pair of ſectoral lines are numbered from the centre, and ſo arranged as to make equal angles at the centre; therefore, at whatever diſtance the ſector is opened, the angles will always correſpond; that is, the diſtance or radius from 60 to 60 on the line of chords, are equal to 10 and 10 on the line of lines, 45 and 45 on the line of tangents, and 90 and 90 on the line of ſines.

The lines of chords, ſines, &c. are conſtructed as thoſe on the Gunter ſcale, making 60 on the line of chords the radius of the circle.

The sectoral lines are like so many similar triangles, namely, that their corresponding sides are proportional, thus: let AC, AE, represent in plate 1. fig. 1. a pair of sectoral lines, forming the angle CAE, divide each leg into any number of equal parts (say 10) draw lines to any of the corresponding numbers, and each will be a similar triangle to CAE, and if the lines AC, AE, should represent the line of chords, sines, or tangents, and CE the radius, and D on the chord, sine, or tangent, any proposed number, then the transverse measure BD will be the chord, sine, or tangent of that number.

In describing the use of the sector, the term *lateral distance* is the distance on one leg, only taken from the centre to any part of a sectoral line; and the *transverse distance* is that taken between any two corresponding divisions on a scale of the same name. All are measured on the lines of each scale that are nearest each other.

The Line of Lines, or Proportional Scale.

The line of lines is used to divide a given line into any number of equal parts: suppose for example 8 deg. take the length of the line given in the compasses, and make it a transverse distance from 8 to 8, then will the transverse distance from 1 to 1 be one of the equal parts, or $\frac{1}{8}$ of the whole; from 2 to 2 will be the 2d, &c.; but if the line to be divided be too long for the legs of the sector, make any division so that it may be applied to the sector, multiplying each transverse distance by the same number you divided by.

To find a fourth proportional to any 3 given lines or numbers, as suppose 6, 2, and 4, take the lateral distance of 2 in your compasses, and make it the transverse distance at 6, then the transverse distance of 4 will give the lateral distance of 1 and $\frac{1}{3}$. Or if a ship sailed 64 miles in 8 hours, how many miles did she sail in 5 hours at the same rate of sailing? Make the lateral distance of 64 the transverse distance at 8 and 8, then the transverse distance of 5 and 5 will give the lateral distance of 40, the fourth proportional. Having a chart constructed upon a scale of 5 miles to an inch, the sector is adjusted to a corresponding scale, by making the transverse distance from 5 to 5 equal to one inch. And to reduce a chart of 6 inches to a degree, to one of 4 inches to a degree, make the transverse distance of 6, 6, equal to the lateral distance of 4, then any distance from the chart set off laterally the corresponding transverse distance will be the distance required. And if you have a chart of 3 inches to a mile, to enlarge to 5 inches to a mile, make the transverse distance of 3, 3, equal to the lateral distance of 5, and proceed as before. A third proportional is found to two numbers; thus having 6 and 4 given to find a third proportional, make the transverse distance at 4 and 4, the lateral distance of

of 6, then the lateral diſtance of 4 will give the tranſverſe diſtance of 2,66 nearly.

Uſe of the Line of Chords.

The line or ſcale of chords is uſed for protracting any angle; you open the ſector to any radius within compaſs of the inſtrument, and the tranſverſe diſtance of any degree required is to be laid down on the circumference of the circle; but if you want it to any particular radius, as, for inſtance, to one inch, make the tranſverſe diſtance between 60 and 60 equal to 1 inch, then you may take off tranſverſly any degree under 60, but for any degree above 60, lay off the radius firſt on the circumference, and the exceſs above 60 taken tranſverſely, are to be laid off on the circumference from the radius juſt before laid down. The meaſure of any angle is found by taking the diſtance of the legs on the circumference, and applying it tranſverſely on the line of chords.

Of the Lines of Sines, Tangents, and Secants.

The tranſverſe diſtance on the line of ſines ſhews the degrees, &c. required; and the tranſverſe diſtance on the line of tangents to 45, do the ſame. But to lay off a tangent above 45 degrees, you muſt take the radius of the tangent 45, and open the ſector that the radius juſt taken may juſt reach to 45,45 on the line of upper tangents marked t, or on the beginning of the ſcale of ſecants, then the ſector is adjuſted to take any tangent above 45 degrees, or any ſecant to 75 degrees.

The Line of Poligons.

Open the ſector that 6,6 be equal to the radius, then the tranſverſe diſtance of any of the numbers on the ſcale will divide the circle into as many ſided poligons.

LOGARITHMS.

LOGARITHMS are a ſeries of numbers, invented by Lord Napier, Baron of Marchinſton, in Scotland, by which the work of multiplication may be performed by addition, and the operation of diviſion may be done by ſubtraction; ſo that great time and trouble are ſaved thereby in the performance of all arithmetical operations; for if the logarithm of any two numbers be added together, the ſum will be the logarithm of the product; and if from the logarithm of the dividend you ſubtract the logarithm of the diviſor, the remainder will be the logarithm of the quotient. Again, if the logarithm of any number be divided by 2, the quotient will be the logarithm of the ſquare root of that number; or, if the logarithm of any number be divided by 3, the quotient will be the logarithm of the cube root of that number.

The

The most convenient series now made use of is the following:

0	1	2	3	4	5	&c. index.
1	10	100	1000	10000	100000,	&c. logarithms.

By which you perceive the index of any logarithm always one less than the number of figures the integer contains.

To find the Logarithm of any Number containing less than 5 Figures.

EXAMPLES.

I would find the logarithm of 7?

Look in the table for the number of 7 in the side column, and against it is 0.84510. This number having but one figure, the index thereto is 0.

I would find the logarithm of 79?

Look in the table for the number of 79 in the side column, and against it is 1.89763; to which 1 is the index, because the number contains two figures.

I would find the logarithm of 763?

Against 763, in the first side column, is 2.88252; to which prefix the index 2, as the number contains 3 places of figures, 2.88252.

To find the Logarithm of 7634.

Find the logarithm of the three first figures in the side column as before; and, casting your eye on the numbers on the top line of the table, look for the remaining figure 4, bring your eye to bear down that column, and right against 763 is the logarithm 88275, to which prefix the index 3, as it contains four places of figures, thus: 3.88275 is the logarithm of 7634.

To find the Logarithm of any whole Number to 5 Places of Figures.

Suppose 76345?

Look out the logarithm of the three first figures 763 in the side column, and the next figure 4 in the top column as before, and against the angle of meeting is 88275, as before. Take the difference between this logarithm and the next greater; that is, the difference between 275 and 281, which is 6; then say, by the rule of three, if 10 gives 6, what will 5 give? that is its half or 3; which, added to the logarithm 88275, makes 88278; to which prefix the index 4, as it contains five places of figures; and that makes the logarithm of 76345 to be 4.88278.

Again, to find the Logarithm of any Number to 6 Places of Figures, as 763458.

Find the logarithm of the 4 first places of figures as before 88275, as above; then say, if 100 gives 6 difference, what will 58 give? Answer 3; which, added to 88275, makes 88278; to which prefix its index 5, makes the logarithm of 763458 to be 5.88278.

To

To find the Logarithm of any mixed Number, as 763.458.

Where the integer is 763, or has only three places of figures, the rule is: Find the logarithm to all the figures, the ſame as if they were whole numbers as before, to which prefix always the index of the integer, which in this number is 2; ſo that the log. of 763.458 is 2.88278, nearly the ſame as above, only differing in its index.

To find the Number anſwering to any Logarithm to 4 *Places of Figures.*

Seek under the column 0, at the top of the table, the next leſs logarithm; note the number againſt it, and carry your eye along that line until you find the neareſt logarithm next leſs than the given one, and you will have the fourth figure at the top of the table, which affix to the three given ones in the firſt ſide column.

What is the number to the logarithm 3.77342?—I look in column 0, and find under it, againſt the number 593, the logarithm 7705; and, guiding my eye along that line, I find the given logarithm 77342 under the column, with 5 at the top; ſo that the number is 5935.

The Number, if taken out by this precept, will be either the Number required, or the next leſs.

To find the Number anſwering any Logarithm to 5 *Places of Figures nearly.*

Find the next leſs logarithm to the given one, and take the difference betwixt it and the given one; alſo take the difference betwixt the next greater logarithm, and next leſs to the given one; then ſay, as the difference of the next greater and next leſs is to 10, ſo is the former difference to the correction ſought;—as, ſuppoſe you would find the number to the logarithm 4.59632.

4.59632			
4.59627	The neareſt next log. I can find is	59627 = its num.	39470
	The next greater ditto is	59638 =	39480
5	- - - Difference	11	10

Then ſay, 11 : 10 :: 5 : 5 nearly the correction; which I add to the number 39470, makes the number ſought to be 39475, anſwering to the logarithm 4.59632.

Note.—Aliquot or even parts may be taken of the difference between the leſs and greater logarithms, where it can be done, thus: In this laſt 5 is nearly the half of 11, as 5, the number ſought, is of 10, the difference of the two numbers belonging to the greater and leſs logarithms, which will often ſave time and trouble.

MULTI-

MULTIPLICATION BY LOGARITHMS.

CASE I.

To find the Product of two whole or mixed Numbers.

Multiply	76	Log.=1.88081	Multiply	76.4	Log.=1.88309
by	54	1.73239	by	5.4	0.73239
Product	4104	=3.61320	Product	412.56	=2.61548

CASE II.

When both, or either, of the fractions are less than unity, as if

0.265	Log. 9.42325	
0.031	8.49136	
.008215	=7.91461	

Here the index of a fraction is 9, when the first decimal figure, as 2, stands in the first decimal place; but if it should stand in the second decimal place, as the 3 in .031, the index will be 8; if it stood in the third decimal place, as .0031, the index would be 7. Thus the number of cyphers prefixed to any decimal, and the index of that decimal, always together make 9; so that if you take the number of cyphers prefixed to the decimal from, 9 remains its proper index. In the addition reject 10 in the sum of the indices; and the proper product, or value of the product, will be obtained. By reason, if 9 represent the index of a fraction, 10 will represent, in this case, the index of unity. Indeed the index of unity may be assumed either 0, 10, 100, &c. as you please; but generally, for most uses, is not wanted to be more than 10, as in the sines, tangents, secants, &c. As 7 or 8 places of decimals are generally sufficient for all purposes, take these two more examples:

Mutiply	3.72	Log.=0.57054	Multiply	59.4	Log.=1.77379
by	0.00064	6.80618	by	.000031	5.49136
Product	.0023808	7.37672	Product	.0018414	7.26515

Here the remainder to 9 is 2 in the index; therefore prefix two cyphers to the number of the log. 23808 for the product required.

DIVISION BY LOGARITHMS.

CASE I.

To divide a whole or mixed Number by a less whole or mixed Number.

Rule. From the logarithm of the dividend subtract the logarithm of the divisor, and the remainder is the logarithm of the quotient.

Divide 4104 by 54.			Divide 410.4 by 54.		
4104	Its logarithm is	3.61321	410.4	Its logarithm is	2.61321
54	Its logarithm is	1.73239	5.4	Its logarithm is	0.73239
76	Quotient =	1.88082	76.0	Quotient =	1.88082

CASE II.

When both, or either, fractions are less than unity?

As divide .008215 by .031

.008215	Its log. is	7.91461
.031	Its log. is	8.49136
.265	Product	9.42325

NOTE.—In the indices here I borrow 10, in the same manner as I flung it away in addition.

Divide .0023808 by 3.72

.0023808.	Its log. is	7.37672
3.72	Its log. is	0.57054
.00064	Quotient	6.80618

NOTE.—If I had assumed the index of unity 100, then the index of the first number would have been 97 or 97.91461,

and .031	98.49136
	99.42325

So that 99 is the index of the first decimal place under 100 in this case.

Divide 59.4 by .000031.

59.4	Its log. is	1.77379
.000031	Its log. is	5.49136
.0001915	Its quotient	6.26515

NOTE.—Whatever index you make represent unity, omit it in the sum of the indices, and borrow it in the subtraction of indices, the sum or remainder will be the true index required.

To EXTRACT THE ROOTS IN LOGARITHMS.

As the multiplying the logarithm of any number by the index of its power produces the logarithm of that power; so the division of any logarithm by its proposed index, the quotient will be the logarithm of the root required.

What is the square root of 324?

324	Its logarithm is	2)2.51054
18	Log. of the root is	1.25527

What is the cube root of 10648?

10648	Its log. is	3)4.02627
22	log. of the root is	1.34209

To find any proposed root of any decimal fraction, you must first prepare the index for the division of the proposed power, thus:—For the square you must add 10 to the index before you divide it; for the cube you must add 20 to its index before you divide it; and so on for the root of any power proposed.

EXAMPLE.—What is the square root of .001849?

.001849	Its log. is	7.26694
	Add	10.
		2)17.26694
.043	The log. of the root is	=8.63347

What is the cube root of 125?

.125	The log. is	9.09691
	Add	20.
	Sum	3)29.09691
.5	Its root	= 9.69897

The

The APPLICATION of LOGARITHMS in meaſuring Boards, Timber, Glaſs, Stone, and all kinds of Packages, uſually taken on board Ships*.

Required the content of a board or plank $9\frac{1}{2}$ feet long and $1\frac{1}{4}$ foot broad?

Log. of $9\frac{1}{2}$ or 9. 5 is		0.97772
	$1\frac{1}{4}$ or 1.25 is	0.09691
11.88 nearly log of cont.		1.07463

or 11 feet $10\frac{1}{2}$ inches nearly.

Required the content of a piece of glaſs 2.9 foot long, and 1.75 broad?

Log. of	2. 9	=0.46240
	1.75	=0.24304
5.075		=0.70544

The content is 5.075 feet.

In like manner may any dimenſions be ſquared, and the content be found.

If the ſolid content be required of any box, bale, &c. add the logarithms of the length, breadth, and depth together, the ſum will be the log. of the ſolid content.

Example.—What is the ſolid content of a box whoſe depth is 2. 7, breadth 2. 3, and length 4. 5 feet.

2. 7	Its log. is	0.43136
2. 3	Its log. is	0.36173
4. 5	Its log. is	0.65321

Sum equal the log. of the content 1.44630=number 27.95 or 28 feet nearly.

The diameter of a caſk at the head and bung, and alſo its length, being given, to find its content in beer and in wine meaſure?

1ſt. Multiply the difference of the head and bung diameter by 0,7, and add the product to the head diameter for a mean diameter.

RULE FOR WINE MEASURE.

Place down the log. of the mean diameter twice the log. of the length, and under theſe two the conſtant log. 7.53148, the ſum of theſe four logarithms will be the log. of the content, abating 10 in the ſum of the indices.

RULE FOR BEER MEASURE.

Put this conſtant log. under the two former logs. always 7.44484 the ſum of the four logs. will be the content for beer gallons, abating 10 in the index.

* The Author has lately publiſhed an improved Gunter's Scale, on which the foot is divided into ten equal parts, and theſe parts ſubdivided into ten equal parts, for the purpoſe of taking dimenſions, and calculating by logarithms or decimal fractions.

EXAM-

EXAMPLE.—What is the content of a caſk whoſe head diameter is 20, the bung diameter 28, and length 40 inches?

Bung diameter	28	
Head diameter	20	
	8	Difference.
	·7	
	5.6	Number to be added to
The head diameter	20 0	
Mean diameter	25.6	

FOR WINE.		FOR BEER.
Log. of mean diam. =	{ 1.40824 1.40824	{ 1.40824 1.40824
Length 40 =	1.60206	1.60206
Conſtant log.	7.53148	7.44484
Log. of 89.13 gallons the content for wine.	1.95002	Anſ. 73 gall. = 1.86338 of beer.

The way theſe two conſtant multiplying logarithms were found is thus:

1ſt. The area of a circle, whoſe diameter is unity, is 7854 decimal parts of the ſquare thereof; ſo that if the ſquare of the diameter of any circle be multiplied by ,7854, the product will be the area of the given circle: hence ,7854 is always a conſtant quantity whoſe logarithm is 9.89509.

2d. If the area of a circle be divided by 231, the number of cubic inches there are in a wine gallon, the quotient will be the number of gallons that circular area contains, at 1 inch deep: hence 231 is a conſtant diviſor. Its logarithm is 2.36361, the arithmetical complement of which is 7.63639, which I add to the former conſtant logarithm 9.89509

The ſum 7.53148 abating 10 in the indices, is the conſtant logarithm to be added, as per rule, for wine meaſure.

For beer meaſure the diviſor is always 282, its log. is 2.45025, whoſe arithmetical complement is 7.54975

Add the conſtant log. 9.89509

Sum 7.44484, the conſtant logarithm for beer meaſure, as per rule, omitting 10 in the index, or ſubtract 2.45025 from 9.89509

Take 2.45025

Remains 7.44484, the ſame as above.

The common Way of finding a Ship's Tonnage at London.

RULE.—Multiply the length of the keel by the breadth of the beam, and that product by half the breadth of the beam, and divide the last product by 94, and the quotient arising is the tonnage.

EXAMPLE.—Suppose a ship 72 feet by the keel, and 24 feet by the beam, what is the tonnage?

Length	72	- -	log. is	1.85733
Breadth	24	- -	do.	1.38021
Half-breadth	12	- -	do.	1.07918
Arith. complement of log. of 94,			do.	8.02687
Tonnage 220.6		- - -		2.34359 Answer.

To find the Logarithm of the Sines, Tangents, and Secants, belonging to any Number of Degrees and Minutes required.

If the required degrees be less than 45, seek the degrees on the top, and the minutes in the left-hand column, marked M, against which, in the column signed at the top with the proposed name, stands the sine, tangent, and secant required; but when the degrees given are more than 45, seek the degrees at the bottom, and the minutes in the right-hand column, marked M at the bottom, and the proposed name at the bottom. Here it may be observed, that the degrees at the top, and minutes at the left-hand column, added to the degrees at the bottom and minutes in the right-hand column, always make 90; hence, if a sine be looked for, the co-sine or complement will be found in the adjoining column, the same may be observed of tangents and secants.

EXAMPLE I. Required the log. sine of 28° 37′?

Find 28 at the top of the page, and, in the left-hand column, marked M at the top, find 37; against which, in the column marked with the word Sine, stands 9.68029, the logarithm of the sine of 28° 37′ required. The same may be observed of tangents and secants.

EXAMPLE II. Required the log. tangent of 67° 45′?

Find 67° at the bottom of the page, and 45′ at the right-hand column marked M at the bottom; against this, in the column marked Tangent at the bottom, stands 10 38816, which is the logarithm required.

Having the sine, tangent, and secant, the co-sine, co-tangent, co-secant, are always found in the adjoining columns.

The logarithm to any number of degrees above 90°, is found by subtracting the given degrees from 180°, and taking the logarithm of the remainder; or, if 90° be subtracted from the given sine, and the log. co-sine of the remainder be taken, it will give the same.

To

To find the Degrees, Minutes, and Seconds, corresponding to any given Logarithm.

If the degrees, minutes, and ſeconds, be wanted to a given logarithmic ſine, or co-ſine thus found, and the next greater, and the next leſs than the given logarithm, and the difference between the given logarithm and the next leſs if a ſine, and the next greater if a co-ſine; then ſay, as the difference between the next greater and next leſs is to 60″, ſo is the difference between the next leſs, if a ſine, and the next greater if a co-ſine, to the number of ſeconds to be annexed to the degrees and minutes found before.

Example I.—Find the degrees, minutes, and ſeconds, correſponding to the log. ſine 9.61405?

Next leſs log.	9.61382	Next leſs log.	9.61382
Next greater	9.61411	Given log.	9.61405
	29		23

Here the given log. is found ſtanding between 24° 16′, and 24° 17′; then, as 29 is to 60, ſo is 23 to 48, which, annexed to 24° 16′, gives 24° 16′ 48″, anſwering to log. 9.61405.

Example II.—Find the degrees, minutes, and ſeconds, correſponding to the log. co-ſine 9.43297.?

The neareſt found between 74° 16′, and 74° 17′.

74° 16′	Next greater log.	9.43323	Next greater log.	9.43323
74° 17′	Next leſs	9.43278	Given log.	9.43297
	Diff.	45	Diff.	26

Now, as 45 is to 60, ſo is 26 to 34″, which, annexed to 74° 16 gives 74° 16′ 34″, the degrees, minutes, and ſeconds required.

To find the Logarithm of the Sine or Co-ſine, for Degrees, Minutes, and Seconds.

Rule.—Find the logarithm to the degrees and minutes as before; take the difference between the logarithm and the next greater in the ſine; but, if a co-ſine, the next leſs; multiply this difference by the odd ſeconds, and divide the product by 60′; add the quotient to the right hand of the log. of the degrees and minutes, if a ſine, but ſubtract it if a co-ſine, the ſum or difference will be the logarithm, ſine, or co-ſine required.

Example I. Required the log. ſine of 24° 16′ 48″?

Sine of 24° 16′	9.61382
Sine of 24° 17′	9.61411
Diff.	29

Now 29 multiplied by 48 gives 1392; this, divided by 60, the quotient, is 23, which, added to 9.61382, gives 9.61405, the log. of 24° 16′ 48″.

Example II. What is the log. co-ſine of 74° 16′ 34″?

Log. co-ſine of 74° 16′	9.43323
Log. co-ſine of 74° 17′	9.43278
Diff.	45

Now 45 multiplied by 34 = 1530; this, divided by 60, gives the quotient 26 nearly; and 26 ſubtracted from 9.43323, leaves 9.43297, the log. co-ſine of 74° 16′, 34″.

If the given ſeconds be $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, or $\frac{1}{6}$, or any other even parts of a minute, the like parts may be taken off the difference of the logarithms, and added or ſubtracted as above, which may be frequently done by inſpection.

To find the Arithmetical Complement of any Logarithm.

The complement arithmetic of any logarithm, is what it wants of 10.00000 or 20.00000, and is uſed to avoid ſubtraction. For finding it this is the rule: Take the reſidue or remainder of the firſt figure from 9, and ſo of the reſt, till you come to the laſt figure; of which take its remainder from 10, and it is done.

Example I.—I would have the complement arithmetic of 9.62595?

For the firſt figure 9, write 0; for 6, 3; for 2, 7; for 5, 4; for 9, 0; and for the laſt figure 5, write 5; and ſo you have 0.37405 for the complement arithmetic ſought.

Example II.—The complement arithmetic of 10.33133?

For 0, write 9, and ſo on as before directed, and then you will have 9.66867, which is the complement arithmetic of 20.33133. Or thus:

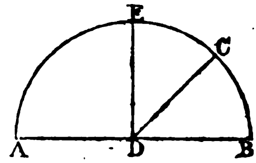
From	10.00000	From	20.00000
Take	9.62595	Take	10.33133
	0.37405		9.66867

It will be neceſſary for the Reader to make himſelf well acquainted with the following propoſitions, as he will find them uſeful when he goes into Trigonometry, which are here rendered plain and eaſy to be underſtood:

Proposition I.—If a right line ſtands upon, or meets with another right line, and makes angles with it, the two angles taken together will be two right angles, or two angles equal to two right angles.

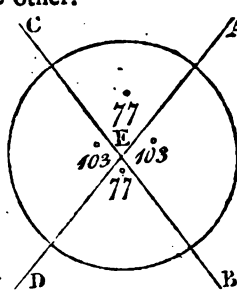
Let

Let the line CD meet AB in D; on D erect the perpendicular DE, with the chord of 60° in your compaſſes, and one foot in D deſcribe the arch AEB, which will be a ſemicircle or 180°; of which AB is the diameter, and the angles ADE and BDE are quadrants, each 90°, becauſe ED is perpendicular to AB; now the angle BDC is leſs than 90°, ſince the two angles together make neither more nor leſs than 180° or a ſemicircle; conſequently any number of right lines ſtanding upon the ſame ſide of the line AB, and coming from the ſame point D, the ſum of all the angles formed by ſuch right lines, cannot exceed 180°. If the angle BDC be ſubtracted from 180°, the remainder will be the angle CDA; or if the angle ADC is given, the angle BDC is found in the ſame manner.



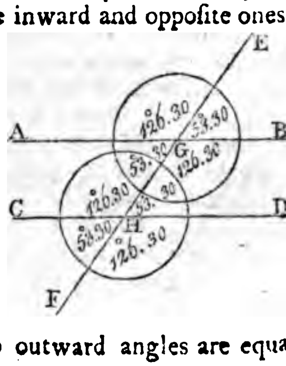
PROPOSITION II.—If two right lines croſs each other, the angles which are oppoſite are equal one to the other.

Let the two lines AD and CB croſs each other in the point E. With the chord of 60°, or any convenient radius, in your compaſſes, and one foot in E, deſcribe a circle; then, by meaſuring the angles, it will be found that the angle AEB is equal to the angle CED, and that the angle AEC is equal to the angle BED; for the angle AEB, added to the angle AEC, makes a ſemicircle; and ſo do the angles BED and DEC; and all the angles taken together, make 360°.



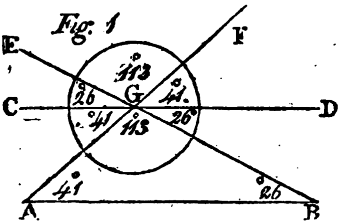
PROPOSITION III.—If a right line croſs two parallel lines, the outward angles will be each equal to the inward and oppoſite ones.

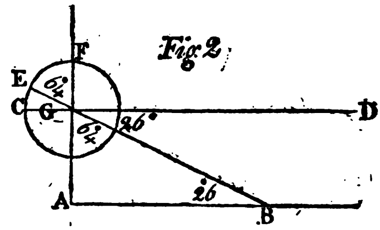
Let the lines AB and CD be parallel lines, and EF the line that cuts them in the points G and H. With the chord of 60° in your compaſſes, and one foot on G and H, deſcribe the arches BEA and DFC, which will be each a ſemicircle; now, by meaſuring the angles BGE and AGE, they will be found equal to the angles DHE and EHC, and each equal to 180, by the firſt propoſition. In like manner it may be proved, that the two outward angles are equal to the two inward and oppoſite ones.



PRO-

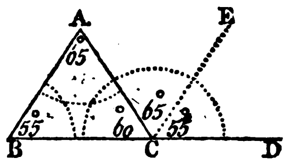
Proposition IV.—In every plane triangle, whether right or oblique, the three angles are equal to two right angles, or 180°.





In the triangle AGB draw CD parallel to AB through the point G; on which point, with the chord of 60°, or any convenient radius, deſcribe a circle; and, with the ſame radius, on A and B deſcribe arches; now, by the laſt propoſition, the angle AGB will be equal to the angles FGE, and the angle ABG will be equal to the angles CGE, and the angle BAG is equal to the angle DGF: now, ſince the oppoſite angles are equal, the angles DGF, FGE, and EGC, together, make a ſemicircle, or 180°; therefore it is plain that the three angles of a plane triangle, whether right, acute, or obtuſe, together, are equal to two right angles, or 180°; hence it follows that, as the right angle BAG, Fig. 2, is 90°, the other two acute angles, ABG, and AGB, taken together, can be no more than 90°; therefore, if one of the acute angles, in a right-angled triangle, be given, the other is found by ſubtracting the given angle from 90°. And in any oblique-angled triangle, if one of the angles be given, the ſum of the other two is found by ſubtracting the given angle from 180°; and if two angles are given, the third is found by ſubtracting the ſum of the two angles from 180°.

Proposition V.—In every plane triangle, if one of its ſides be produced, the outward angle will be equal to the two inward oppoſite angles.



Let ABC be the triangle, and CD the ſide produced, with the chord of 60°, or any other radius, deſcribe arches on AB and C, draw CE parallel to AB; then, by the third propoſition, the angle ACE muſt be equal to the angle BAC, and the angle DCE equal to the angle CBA; therefore the outward angle DCA is equal to the two inward oppoſite angles ACB, and BAC; which may be eaſily proved by meaſuring the angles by the line of chords on the plane ſcale.

Note.—I hope the learned Mathematician will excuſe the method here taken of demonſtrating the above propoſitions in a mechanical manner, judging it beſt adapted to the capacity of thoſe

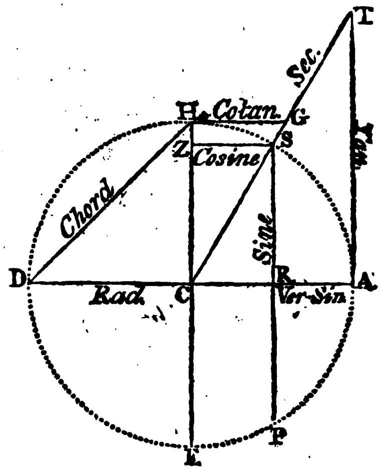
for

for whose use this book is intended, not doubting but the Teacher will, as I always do, demonstrate them in a more geometrical manner to those who are capable of receiving such.

TRIGONOMETRY.

PLAIN Trigonometry is the art of measuring plane triangles, by comparing the sides and angles together by known analogies; whereby three things being given, a fourth may be found, on condition that one of them be a side: but as angles are measured by the arch of a circle, described upon their angular points, and the proportions that these arches bear to right lines cannot be exactly found; therefore the writers on Trigonometry have applied right lines to these arches, that the proportion they bear to the sides of a plane triangle may be found.

The right lines applied to a circle are:



1st. A CHORD, or the subtense of an arch, is a right line that divides the circle into two unequal parts, and is a chord to them both, as DH is the chord of the arches DH and DAH.

2d. A RIGHT SINE of an arch is, a right line drawn from one end or termination of an arch perpendicular to the radius; or it is half the chord of twice the arch; so that RS is the sine of the arch AS, and SZ the co-sine.

3d. A VERSED SINE is that part of the diameter contained between the right sine, and the arch, as RA and RCD, is the versed sine of SHD, or DEP, its equal.

4th. A TANGENT of an arch is a right line drawn perpendicular to the end of the diameter, just touching the arch, as AT is the tangent of the arch AS, and HG the co-tangent.

5th. A SECANT of an arch is a right line drawn from the centre through the circumference, and produced until it cuts the tangent as CT.

NOTE.—The sine, tangent, and secant of the complement of an arch, is called the co-sine, co-tangent, and co-secant of that arch.

The sines, tangents, and secants of an arch, are said to be the measure

meaſure of ſo many degrees as that arch contains parts of 360 degrees; ſo that the radius being the ſine of a quadrant, or a fourth part of a circle, contains 90°, thus: The radius is always equal to the ſine of 90°, as is the chord of 60°, and the tangent of 45°, all the three being each equal to the radius: and that the ſine, tangent, and ſecant of an arch is equal to the ſine, tangent, and ſecant of an arch, as much above 90 degrees as the former was deficient of 90; thus the ſine, tangent, or ſecant of 80° is = 100°, of 70° is 110°, of 60° is = 120°, of 40° is = 140°, &c. ſo that in taking out the logarithms of ſines, tangents, or ſecants, for any number of degrees above 90°, the given angle muſt be ſubtracted from 180°, and the logarithm of the remainder be taken; or ſubtract 90° from the given angle, and take the log. co-ſine, co-tangent, or co-ſecant of the remainder.

Notwithſtanding what has been ſaid in Geometry, it may not be improper here to obſerve that,

1ſt. The feweſt number of right lines that can include a ſpace are three; which is called a triangle, or three cornered figure, and conſiſts of ſix parts, *viz.* three ſides and three angles.

2d. In every triangle the greateſt ſide is oppoſite the greateſt angle; conſequently, the greateſt angle is oppoſite the greateſt ſide.

3d. In every triangle equal ſides ſubtend or ſtand againſt equal angles.

4th. In every plane triangle the three angles together are equal 180°.—See Prob. 3d, in Geometry.

5th. If in a triangle, one angle be right or obtuſe, the reſt are acute; and if one angle in a triangle be right, the other two taken together, make one right angle, or 90°; wherefore, if one of the acute angles, in a right-angled triangle, be known, the other is found by ſubtracting the known angle from 90°.

6th. In every plane triangle, if one of the angles be given or known, the ſum of the other two is found by ſubtracting the given angle from 180°, and if two of the angles be known or given, the third is found by ſubtracting their ſum from 180°.

7th. The complement of an angle is what it wants of 90°.

8th. The ſupplement of an angle is what it wants of 180°.

9th. All angles are meaſured by the arch of a circle, deſcribed about their angular points with the chord of 60°, and ſaid to be greater or leſs, according to the number of degrees or parts to be contained between their legs; which legs may be ſuppoſed to be yards, miles, leagues, &c. and are meaſured on a ſcale of equal parts.

10th. A circle deſcribed with a chord of 60°, the circumference will contain four right angles, or 360°, the quadrant 90°, and ſemicircle 180°.

11th. The angles of two triangles may be reſpectively equal, although

although their ſides may be unequal. Therefore, among the things given, in order to find the reſt, one of them muſt be a ſide.

In Trigonometry, the three parts given, in all triangles, muſt be either

1ſt. Two ſides and an angle oppoſite one of them.

2d. Two angles and a ſide oppoſite one of them.

3d. Two ſides and the included angle.

4th. Three ſides.

In either caſes, the other three things may be found by help of the table of logarithms, artificial ſines, tangents, and ſecants, by the following axioms; as well as by the foregoing conſtructions.

☞ It may not be improper here to obſerve, that the properties of a right-angled triangle depend on the 47th propoſition of the firſt book of Euclid, where it is demonſtrated, that

In every right-angled triangle, the ſquare of the hypothenuſe, or longeſt ſide, is equal to the ſum of the ſquares of the other two ſides or legs; conſequently, having the ſquares of the baſe and perpendicular, the ſquare root of their ſum will be the length of the hypothenuſe.

And, if the ſquare of the baſe be ſubtracted from the ſquare of the hypothenuſe, the ſquare root of the remainder will be the length of the perpendicular.

And, if the ſquare of the perpendicular be ſubtracted from the ſquare of the hypothenuſe, the ſquare root of the remainder will be the length of the baſe; conſequently, by having any two ſides of a right-angled triangle, the third ſide may be found.

Thus the lines of the lengths 5, 4, 3, (or their doubles, trebles, &c.) will form a right-angled triangle.

Now the ſquare of 5 is 25, the ſquare of 4 is 16, and the ſquare of 3 is 9; then 16 and 9 is 25, its root is 5, the length of the hypothenuſe; and, if 16 be ſubtracted from 25, the remainder is 9, its root is 3, the length of the perpendicular; again, if 9 be ſubtracted from 25, the remainder is 16, its root is 4, the length of the baſe: the ſame of any other numbers, which may be readily done by the logarithms, or by the extraction of the ſquare root.

The Solution of the ſeveral Caſes, in Plain Trigonometry, depend upon four Propoſitions, called Axioms, which the Learner ſhould get perfectly by Heart.—We ſhall here give the firſt Axiom only, and the reſt before we begin Oblique Sailing.

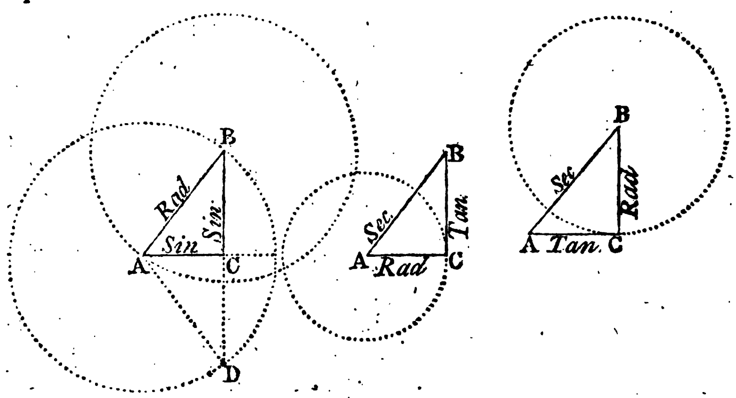
AXIOM I.

In any right-angled plane triangle,

If the hypothenuſe be made the radius of a circle, the other two ſides, or legs, will be the ſines of their oppoſite angles; but

If either of the legs, including the right angle, be made the radius of a circle, the other leg will be the tangent of its oppoſite angle, and the hypothenuſe the ſecant of the ſame angle.

For let the three following triangles have their ſides and angles equal:



It is plain, by comparing theſe with the firſt figure in Trigonometry, that, taking the hypothenuſe AB as radius, in your compaſſes, and on A and B deſcribe circles, CB will be the ſine of the angle BAC, and CA will be the ſine of the angle ABC, and BC will be the ſine of half the arch BD, or the ſine of half the angle BAD, being half the chord of twice the arch; but, taking the baſe AC, as a radius, in your compaſſes, and with one foot in A deſcribe a circle, it is plain that CB will be the tangent, and AB the ſecant of the ſame angle; but if CB, the perpendicular, be taken as the radius, and a circle be deſcribed on B, then will AC be the tangent of its oppoſite angle ABC, and the hypothenuſe the ſecant of the ſame angle: for it ſhould be remembered, that when any one of the legs becomes a tangent of its oppoſite angle, the hypothenuſe always accompanying it, becomes the ſecant of the ſame angle.

Now ſince, by making any of the ſides of a right-angled triangle the radius of a circle, we can readily find the names or denominations of the other ſide, it comes next to be conſidered what parts or things are given, and what required, in order to ſtate the queſtion. In this caſe we ſhall compare Trigonometry with the Rule of Three in common Arithmetic; where we are taught to conſider what name or denomination the anſwer is to be of, which name muſt always be made the ſecond term in ſtating the queſtion; if pounds are to be the fourth number, or anſwer, then pounds muſt be the ſecond term; if yards are to be the anſwer, then yards muſt be the ſecond term. As for example, if 60 yards coſt £.120, what will 90 yards coſt? Then pounds being wanted, pounds muſt be the ſecond term.

If 60 yards coſt £.120, what will 90 yards coſt?

$$\begin{array}{r} 90 \\ \hline 6,0)\,1080(0(180 \text{ Anſwer.} \end{array}$$

It is the ſame in Trigonometry; for if the fourth number, or anſwer, is to be an angle, an angle implied muſt be the ſecond term, and ſides the firſt and third terms; but when a ſide is required, a ſide muſt be placed the ſecond term, and angles the firſt and third terms, in ſtating the queſtion; conſequently, in all queſtions in Trigonometry, if a ſide is required, you muſt begin with an angle or radius, which is always conſidered as a given angle, equal to 90°; but when an angle is required, then you muſt begin with a known ſine.

In the Rule of Three we multiply the ſecond and third terms together, and divide that product by the firſt term, and the quotient will be the fourth number ſought, and of the ſame denomination the ſecond term is of. Now, ſince the addition of logarithms anſwers the purpoſe of multiplication of whole numbers, and ſubtraction that of diviſion, add the logarithms of the ſecond and third terms together, and from their ſum ſubtract the logarithm of the firſt term, the remainder will be the logarithm of the fourth term. Or to the complement arithmetic of the logarithm of the firſt term, add the logarithms of the ſecond and third term, the ſum abating radius will give the ſame anſwer.

As log. .. 60		1.77815	Coar. 8.22185
Is to log. of 120		2.07918	2.07918
So is log. .. 90		1.95424	1.95424
	Add	4.03342	12.25527
Firſt term ſub. 60	is	1.77815	
To anſwer 180	=	2.25527	

Here it is plain the logarithms give the ſame anſwer as that given by the Rule of Three.

In a right-angled triangle there are always two ſides, or the angles and one ſide given, to find the reſt.

To find a ſide, any ſide may be made radius; then ſay, as the name of the given ſide is to the given ſide, ſo is the name of the ſide required to the ſide required, which muſt be found among the logarithms.

To find an angle, one of the given ſides muſt be made radius; then ſay, as the ſide made radius is to radius, ſo is the other given ſide to the ſine, tangent, or ſecant, by it repreſented; which being looked for in the table of ſines, tangents, and ſecants, there will be found the degrees and minutes correſponding to the angle required.

Solution

Solution of the Six Cafes in Right-angled Trigonometry,

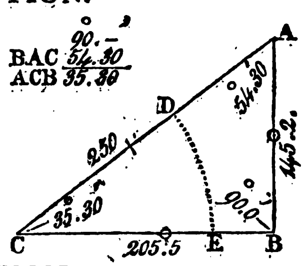
CASE I.

The Angle and Hypothenufe given, to find the Legs,

Given the hypothenufe AC 250 leag. and the angle oppofite to the bafe CB=54° 30′, to find the bafe CB and perpendicular AB.

By CONSTRUCTION.

Draw the bafe CB of any length, on C defcribe the arch DE, from E to D lay off 35° 30′, through C and D draw a line, which muft be equal to 250; from A let fall the perpendicular AB, to cut CB in B, and it is done; for CB will be 203.5, and AB=145.2.



By CALCULATION.

By making the Hypothenufe CA Radius, it will be,

To find the bafe BC.		To find the perpendicular AB.	
As radius	10.00000	As radius	10.00000
Is to the hypoth. CA 250	2.39794	Is to the hypoth. CA 250	2.39794
So is the fine ang. A 54° 30′	9.91069	So is fine ang. C 35° 30′	9.76395
	12.30863		12.16189
	10.00000		10.00000
To the bafe BC=203.5	2.30863	To the per. AB 145.2	2.16189

By making the Bafe Radius, the Proportion by Axiom the firft, will be,

To find the bafe BC.		To find the perpendicular AB.	
As fec. ang. C 35° 30′	10.08931	As fec. ang. C 35° 30′	10.08931
Is to hypo. AC=250	2.39794	Is to hypoth. AC=250	2.39794
So is radius	10.00000	So is tang. ang. C 35° 30′	9.85327
	12.39794		12.25121
	10.08931		10.08931
To the bafe BC=203,5	2.30863	To the per. AB 145,2=	2.16190

By making the Perpendicular Radius, by Axiom the firft it will be,

To find the bafe BC.		To find the perpendicular AB.	
As fec. ang. A 54° 30′	10.23605	As fec. ang. A 54° 30′	10.23605
Is to hypoth. AC 250	2.39794	Is to hypoth. AC 250	2.39794
So is tang. an. A 54° 30′	10.14673	So is radius	10.00000
	12.54467		12.39794
	10.23605		10.23605
To the bafe BC=203,5	2.30862	To the per.=AB 145,2	2.16189

NOTE.

NOTE.—In the first stating, where the hypothenuse is made radius, the sum of the logarithms of the second and third terms are 12,30863, from which it is easy to subtract the logarithm of the first term; for you may either cancel it, or leave it out; and then cast off the first figure towards the left hand, and it will leave the logarithm 2.30863, the same as if 10.00000 had been set down and subtracted from it; and, indeed, the five cyphers may be always omitted in the radius, and only the index 10 set down.

It will greatly expedite the working the proportions by logarithms, if the two or all the statings be first made, and then the sines, tangents, or secants, may be taken out at one opening of the book; for if one angle of a right-angled triangle be given, the logarithm of its complement, or the other angle, whether sine, tangent, or secant, is found in the adjoining column, without being at the trouble of subtracting the given angle from 90°. If the given angle be less than 45 degrees, it is found at the top of the table, and the minutes in the left-hand column reckoned downwards, and its complement is found at the bottom, and the minutes on the right-hand column. On the contrary, if the given angle is found at the bottom, its complement, or the other angle, will be at the top of the table, and the minutes in the left-hand column, against which is the log. sine, tangent, or secant, corresponding to it.

By GUNTER's SCALE.

In all proportions wrought by Gunter's Scale, when the first and second terms are of the same kind, then the extent from the first term to the second, will reach from the third to the fourth;

Or when the first and third terms are of the same kind,

The extent from the first term to the third will reach from the second to the fourth; that is, set one point of the compasses on the division expressing the second term, then, without altering the opening of the compasses, set one point on the division representing the third term, or second term, and the other point will fall on the division shewing the fourth term or answer.

Now, in this last case, it will run thus:

Extend from radius, or 90°, to 54° 30′, on the line of sines, that extent will reach from 250, the hypothenuse, to 203,5, the base, on the line of numbers; and the extent from radius, or sine of 90°, to 35° 30′ on the line of sines, will reach from 250 to 145 on the line of numbers.

Observe the like in all that follows, except in those proportions where the word secant is mentioned, which may be readily wrought by considering the hypothenuse radius, as in the last case; there being no line of secants on Gunter's Scale.

NOTE.

NOTE. The radius, according to the nature of the proportion, may be any of these:

8 Points on the line of Rhumbs.	90° On the line of Sines.
4 Points on the line of Tan. Rhbs.	45° On the line of Tangents.

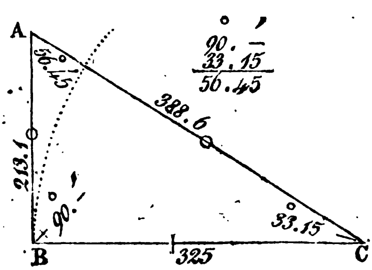
CASES II. and III.

The Angles and one Leg given, to find the Hypothenuse and other Leg.

The angle ACB 33° 15′, the leg BC 325 miles given, to find the hypothenuse and the other leg.

By CONSTRUCTION.

Draw the line BC, which make equal to 325 miles; on B erect the perpendicular BA; on C describe an arch with the chord of 60°, and make the angle C=33° 15′, through where that cuts the arch draw AC to cut AB in A, and it is done; for BA being measured on the side scale that BC was, will be 213,1, and AC 388,6 miles.



By making the Hypothenuse AC Radius, it will be,

To find the perpendicular AB.		To find the hypothenuse AC.	
As sine ang. A 56° 45′	9.92235	As sine ang. A 56° 45′	9.92235
Is to the base BC 325	2.51188	Is to the base BC 325	2.51188
So is sine ang. C 33° 15′	9.73901	So is radius 90°	10.00000
	12.25089		12.51188
	9.92235		9.92235
To the perpen. AB 213,1	2.32854	To the hypoth. AC 388,6	2.58953

By making the Base BC Radius, it will be,

To find the perpendicular AB.		To find the hypothenuse AC.	
As radius 90°	10.00000	As radius 90°	10.00000
Is to the base BC 325	2.51188	Is to the base BC 325	2.51188
So is tang. ang. C 33° 15′	9.81666	So is sec. ang. C 33° 15′	10.07765
	12.32854		12.58953
	10.00000		10.00000
To the perpen. AB 213,1	2.32854	To the hypoth. AC 388,6	2.58953

By

By making the Perpendicular AB Radius, it will be,

To find the perpendicular AB.		To find the hypothenuse AC.	
As tang. ang. A 56° 45′	10.18334	As tang. ang. A 56° 45′	10.18334
Is to the base BC 235	2.51188	Is to the base BC 325	2.51188
So is radius 90°	10.00000	So is sec. ang. A 56° 45′	10.26099
	12.51188		12.77287
	10.18334		10.18334
To the perpen. AB 213,1	2.32854	To the hypoth. AC 388,6	2.58953

By GUNTER.

'Extend from 56 degrees 45 minutes, to 33 degrees 15 minutes, on the line of sines, that extent will reach from the base 325, to the perpendicular 213,1, on the line of numbers.

'2dly. 'Extend from 50 degrees 45 minutes to radius on the line of sines, that extent will reach from the base 325, to the hypothenuse 388,6 on the line of numbers.'

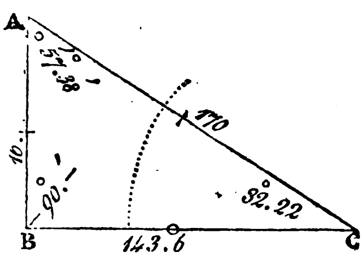
CASES IV. and V.

The Hypothenuse and one Leg given, to find the Angles and the other Leg.

The Leg AB 91, the hypothenuse 170 given, to find the angle ACB, or BAC, and the leg BC.

By CONSTRUCTION.

Draw BC at pleasure, on B erect the perpendicular BA, which make equal to 91, take 170 in your compasses, and, with one foot on A, lay the other on the line BC, and join A and C, and it is done; for the angle C will be 32° 22′, the angle A 57° 38′, and BC 143,6.



By making the Hypothenuse Radius, it will be,

To find angle C.		To find the base CB.	
As the hypoth. 170	2.23045	As radius	10.00000
Is to the radius	10.00000	Is to the hypoth. 170	2.23045
So is the perpend. 91	1.95904	So is sine ang. A 57° 38′	9.92667
	11.95904		12.15712
	2.23045		10.00000
To sine ang. C 32° 22′	9.72859	To the base 143,6	2.15712

By

By making the Perpendicular Radius, it will be,

To find the angle A.		To find the base BC.	
As the perpendicular 91	1.95904	As the radius	10.00000
Is to the radius	10.00000	Is to the perpend. 91	1.95904
So is the hypoth. 170	2.23045	So is tang. ang. 57° 38′	10.19805
	12,23045		12.15709
	1.95904		10.00000
To sec. ang. A 57° 38′	10.27141	To the base 143,6	2.15709

By GUNTER.

'Extend from hypothenuse 170 to the perpendicular 91 on the line of numbers; that extent will reach from radius to sine angle C, the complement of angle A=32 degrees, 22 minutes, on the line of sines.

2dly. 'Extend from radius to sine angle A 57 degrees, 38 minutes; that extent will reach from the hypothenuse 170, to the base 143.6 on the line of numbers.'

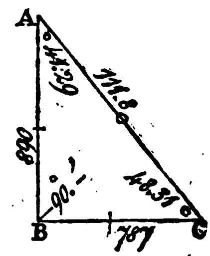
CASE VI.

The Legs given, to find the Angle and Hypothenuse.

The legs AB 890, BC 787 given, to find the angle BAC, or ACB, and the hypothenuse AC.

By CONSTRUCTION.

Make BC=787, and on B erect the perpendicular BA, which make equal to 890; join AC, and it is done; for the angle C will be 48° 31′; consequently, the angle A 41° 29′, and hypothenuse 1188.



By making the Base Radius, it will be,

To find angle C.		To find the hypoth. AC.	
As the base 787	2.89594	As rad. tan. 45°	10.00000
Is to rad. tan. 45°	10.00000	Is to the base 787	2.89597
So is the perpend. 890	2.94939	So is sec. ang. C 48° 31′	10.17888
	12.94939		13.07485
	2.89597		10.00000
To tan. ang. C=48° 31′	10.05342	To the hyp. AC=1182	3.07485

By

By making the perpendicular radius, it will be,

To find angle A.		To find the hypoth. AC.	
As the perpend. 890	2.94939	As rad. tan. 45°	10.00000
Is to rad. tan. 45°	10.00000	Is to the perpend. 890	2.94939
So is the base BC=787	2.89597	So is sec. ang. A 41° 29′	10.12543
	12.89597		13.07482
	2.94939		10.00090
To tan. ang. A 41° 29′	9.94658	To the hyp. AC=1188	3.07482

By GUNTER.

'The extent from 787 to 890 on the line of numbers will reach from radius (or 45 degrees) to 41° 29′ on the line of tangents.

2dly. 'The extent from sine angle C 48 degrees, 31 minutes, to radius, or 90 degrees, will reach from the base 890 to the hypothenuse 1188, on the line of numbers.'

Questions to exercise the Learner in Trigonometry.

Quest. 1. The hypothenuse 496 miles, and the angle opposite to the base 56° 15′ given, to find the base and perpendicular.

Ans. Base 412,4, and the perpendicular 275,6 miles.

Quest. 2. The perpendicular 275 leagues, and the angle opposite to the base 56° 15′ given, to find the hypothenuse and base.

Ans. The hypothenuse 495, and base 411,6 leagues.

Quest. 3. The base 33 yards, and the angle opposite to the perpendicular 53° 26′ given, to find the hypothenuse and perpendicular.

Ans. Hypothenuse 55,39, and the perpendicular 44,49 yards.

Quest. 4. The hypothenuse 575, and perpendicular 50 miles given, to find the base.

Ans. Base 572,8 miles.

Quest. 5. The hypothenuse 59, and the base 33 miles given, to find the perpendicular.

Ans. Perpendicular 48,9 miles.

Quest. 6. The base 33, and perpendicular 52 leagues given, to find the hypothenuse.

Ans. Hypothenuse 61,59 leagues.

AN

INTRODUCTION

TO THE

ART OF NAVIGATION.

BEFORE we begin Navigation, it may not be improper to give the Learner some idea of the System of the Universe, commonly called the Solar, or Copernican System, which is as follows:—

The Sun, that immense and amazing fountain of heat and light of the whole system, is placed near the common centre of the orbits of seven opaque spherical bodies, which make their revolutions round it, in less or more time, according to their several distances from it.

Mercury is nearest to the Sun, and receives its light and heat from it, and revolves round it in ellipsis in two months and twenty-eight days.

Venus is somewhat higher in the system, and describes its ellipsis round the Sun in seven months and fifteen days, and becomes our evening and morning star by turns.

The Earth is next to Venus, and describes an ellipsis round the Sun in 365¼ days, or one year, which being at a greater distance from the Sun than the former planets, and therefore receiving less of its light and heat, to make up the deficiency, the wise Author of Nature has caused a secondary planet, called the Moon, to move round it in 27 days, 12 hours, and 44 minutes; it receives its light and heat from the Sun, and reflects it upon the Earth, which, in some measure, compensates for the absence of the Sun, during the winter seasons, in the North and South.

Mars is still higher in the System, and takes a larger circuit, revolving round the Sun in 1 year, 10 months, and 22 days.

Jupiter is the largest of all the planets, and describes a large ellipsis round the Sun in 11 years, 10 months, 27 days; there are four Satellites, or Moons, moving round it; they receive their light from the Sun, and reflect it upon their primary planet, as the Moon does upon the Earth.

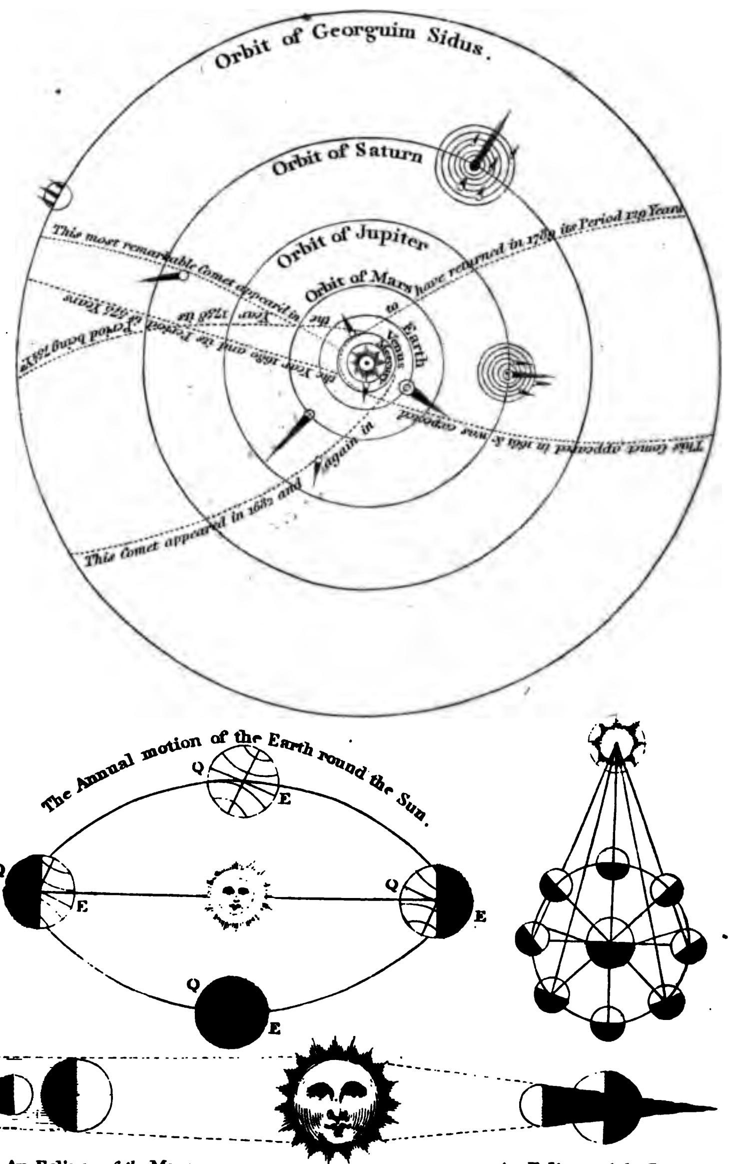
Saturn revolves round the Sun in 29½ years, has 5 Moons which move round him, and is also surrounded with a prodigious ring or atmosphere.

The Georgium Sidus is the most remote of all the planets, and is attended by two Satellites: the first or nearest of which performs a synodical revolution in about 8 days and three quarters.

The

Face Page 42.

THE SOLAR SYSTEM.



An Eclipse *of the* Moon. An Eclipse *of the* Sun.

Perry sculp.

Published by J.Johnson & the rest of the Proprietors July 1.1806.

The ſecond (which is about half as far again diſtant from its primary planet) is about 13 days and a half in performing its ſynodical revolution.

The fixed ſtars are ſuppoſed to be of the ſame matter with the Sun, and made for the ſame ends; each of them the centre of its own proper ſyſtem, having planets moving round them as our Sun has.

Comets are a ſort of planets moving round the Sun, in ellipſes, ſo very oblong, that their viſible parts ſeem to be, in a manner, parabolical, but have ſuch vaſt atmoſpheres about them, and tails derived from the ſame, eſpecially when they come near the Sun, as imply them deſigned for very different purpoſes from the other planets.

Having given a curſory View of the Syſtem of the Univerſe, we ſhall now conſider the Earth a little more particularly; a perfect knowledge of the figure and motion of which, with various real and imaginary lines upon it, is abſolutely neceſſary in the Art of Navigation.

The land and water of this Earth, or Planet, upon which we live, make a compoſition of a ſpherical form, or rather an oblate figure, called the Terraqueous Globe, which, by turning round its axis every 24 hours, from Weſt to Eaſt, cauſe all the heavenly bodies to revolve, apparently, from Eaſt to Weſt in the ſame time, making the viciſſitudes of the day and night; and this Earth, together with its Moon, by moving round the Sun in 1 year, or in 365 days 6 hours nearly, produce the ſeaſons of the year, viz. Winter, Summer, Autumn, and Spring.

The Earth is endowed with a wonderful principle of gravitation, whereby all its parts are ſtrictly united together; and all bodies that are looſe upon it cloſely adhere to its ſurface, tending directly to its centre. Hence it is, that ſhips are able to ſail with the ſame facility every where (void of impediments) upon the ſurface of the ſea, quite round the Terraqueous Globe, and that, (as to ſenſe) there is no ſuch thing as an upper or lower part of the Earth; for let the inhabitant be in what part ſoever, he will there gravitate towards the Earth's center, and imagine himſelf to be on the higheſt point of its ſurface; from whence he will obſerve the Heavens like a large vault over his head, and his Antipodes he will imagine to be directly under him; as they will alſo their's, for the like reaſon,

According to this law of Gravity, if the Earth were at reſt, (and not acted upon by any other power) and its parts looſe, or its ſurface all over covered with a deep fluid, it would naturally form itſelf into a true Sphere or Globe. But, admitting the earth revolves about its own axis, with a rapid motion from Weſt to Eaſt in 24 hours, the gravity towards its centre will thereby be diſturbed, and all the parts endeavour to fly off from the axis of the motion;

and this inclination is greateſt to that part of the ſurface, which is at the greateſt diſtance from the axis; and, conſequently, the gravity towards the centre is there the leaſt: whence it will follow, that thoſe parts which gravitate the leaſt, muſt yield or give way to thoſe that have a greater gravitation, to reſtore an equilibrium; and, conſequently, here will be formed a Spheroid, whoſe greateſt diameter will be perpendicular to the axis of motion, (commonly called the Earth's axis) and the ſhorteſt diameter will be the axis itſelf.

It is demonſtrated by the writers on mechanics, that the times of the periodical vibrations of all pendulums of equal lengths are in a certain proportion to the gravity by which they are acted upon; and it has alſo been demonſtrated, that gravity acts in a certain proportion to the diſtance from its center. Hence, by the help of pendulums, we may find the proportion of gravity upon any part of the earth; and, conſequently, the proportional diſtance of that part to the diſtance of any other part from the Earth's centre. Now, it has been found by experience, that the degree of gravitation upon the Earth's ſurface under the equinoctial, is to the ſame in any parallel of latitude, in the ſame proportion (as near as obſervation could be made) that it would be, if the whole body of the Earth was compoſed of a fluid ſubſtance, and ſo formed itſelf into ſuch a figure as above-mentioned. Hence we may infer, that the Earth is a Spheroid; and its greateſt diameter (which is under the Equinoctial) is computed to be to the leſſer diameter, (which is under the Poles, or the Earth's axis) as 289 to 288; and, conſequently, the ſpace upon the Earth's ſurface, anſwering to a degree of a great circle where it is the greateſt, (or under the Equinoctial) is to the ſpace anſwering to a degree near the Poles, (where it is leaſt) as 289 to 288; or as 1000 to 996,5 nearly: but this difference is ſo ſmall, that in all aſtronomical and geographical caſes, the figure of the Earth may be eſteemed truly ſpherical, though the ſmall difference from it does ſenſibly affect the motions of pendulums.

That the earth is round, or nearly ſo, will appear, not only from the circular ſhadow it has upon the Moon, when that body happens to be eclipſed by it, but alſo from the very appearance of the Sea, and the many obſervations made by perſons ſtanding upon the ſhore, and viewing a ſhip departing from the port: they firſt loſe ſight of the body of the veſſel, whilſt they can ſtill ſee the rigging and uppermoſt ſails: but as the ſhip recedes farther, they loſe ſight of theſe alſo, as if the whole were ſunk in the deep. Again, in a ſhip making towards the land, the mariners firſt deſcry the tops of ſteeples, trees, &c. pointing above the water; next they ſee the buildings themſelves; and laſtly the ſhore, which can only be the effects of the Earth's rotundity.

Its being a globe is alſo confirmed by the many voyages which have been made round it from Eaſt to Weſt; firſt by Magellan's

ſhip

ſhip in the years 1519, 1520, 1521, in 1124 days; by Sir Francis Drake, in the years 1577, 1578, 1579, 1580, in 1056 days; by the late lord Anſon, in 4 years; and lately by the Captains Byron, Carteret, Cook, and Clarke, accompanied with ſeveral able mathematicians and naturaliſts, whoſe obſervations and diſcoveries do honour to this nation, as well as greatly contribute to the improvement of Geography and Navigation: they having diſcovered many iſlands in the South Seas, which were formerly unknown to Europeans.

The little unevenneſs of the Earth's ſurface, ariſing from the hills and vales, are no material objection to its being conſidered as round: ſince the higheſt hill or mountain bears not ſo great a proportion to the bulk of the Earth itſelf, as the little riſing upon the coat of an orange bears to the bigneſs of that fruit.

In order to deſcribe the poſition of places, geographers have found it neceſſary to imagine certain circles drawn upon the ſurface of the Earth; to which they have given the names of Equator, Meridian, Horizon, Parallels of Latitude, &c.

I. The axis is a ſtrait line, imagined to paſs through the centre of the Earth; the extreme points are the poles, on which the Earth is ſuppoſed to move, one called the Arctic, or North Pole, and the other the Antarctic, or South Pole.

II. The Equator is a great circle under the Equinoctial Line in the Heavens, compaſſing the Earth in the middle, between the two Poles, and divides it into two equal parts, called the Northern and Southern Hemiſpheres: from it the latitude of places is reckoned, either North or South; and on it are counted the degrees of longitude from Eaſt to Weſt. This circle is called the Equator, becauſe when the Sun comes to it, which is twice a year, viz. about the 21ſt of March, at his entrance into Aries, and again into Libra about the 23d of September, then making equal day and night throughout the World.

III. The Meridians are circles which paſs through the Poles of the Earth, the Zenith, and Nadir, croſſing the Equator at right angles, and dividing the Earth into two equal parts, one Eaſt and the other Weſt; and is ſo called, becauſe when the Sun comes to the meridian of any place, it is then noon or mid-day. They are infinite in number, for all places, from Eaſt to Weſt, have their ſeveral meridians; of theſe, one is called the firſt or chief Meridian, from which the longitude of places is reckoned; it is of ſpecial note and uſe, but variouſly placed by geographers; ſome placing it at London, others at Paris, Teneriffe, &c.; and, ſince the Earth turns once round its axis in 24 hours, every point upon its ſurface deſcribing a circle of 360 degrees in that time; therefore, any place lying 15 degrees to the eaſt of us, has the Sun upon its meridian one hour ſooner; or it is twelve o'clock with the eaſternmoſt, when it is eleven with us; and any place, 15 degrees to the weſtward of us, has the Sun one hour after us.

IV. Latitude

IV. Latitude is the neareſt diſtance of any place from the Equator; it is meaſured on an arch of the Meridian, intercepted between the place and the Equator, and therefore can never exceed 90 degrees. It takes its name according as the place is ſituated, either North or South of the Equator; therefore, all places that lie at the ſame diſtance from, and on the ſame ſide of, the Equator, are ſaid to be under the ſame parallel of Latitude.

Parallels of Latitude are circles parallel to the Equator.

The difference of Latitude is an arch of the meridian, contained between two parallels of Latitude; or it is the leaſt diſtance of the parallels of Latitude of two places; ſhewing how far one of them is to the northward or ſouthward of the other, and can never exceed 180 degrees.

V. The longitude of any place on the earth is expreſſed by an arch of the Equator, ſhewing the eaſt or weſt diſtance of the meridian of that place, from ſome fixed meridian, where Longitude is reckoned to begin.

Difference of Longitude is an arch of the Equator, intercepted between the meridians of two places, ſhewing how far one of them is to the eaſtward or weſtward of the other.

Longitude begins at the meridian of ſome place, and is counted from thence both eaſtward and weſtward, and can never exceed 180 degrees.

VI. The horizon is that apparent circle which limits or bounds the view of a ſpectator on the ſea, or an extended plain; the eye of the ſpectator being always ſuppoſed the centre of his horizon.—Every part of this circle is 90 degrees from the centre of it over our heads, which point is called the Zenith; and the point of the Heavens oppoſite to it, or under our feet, is called the Nadir.

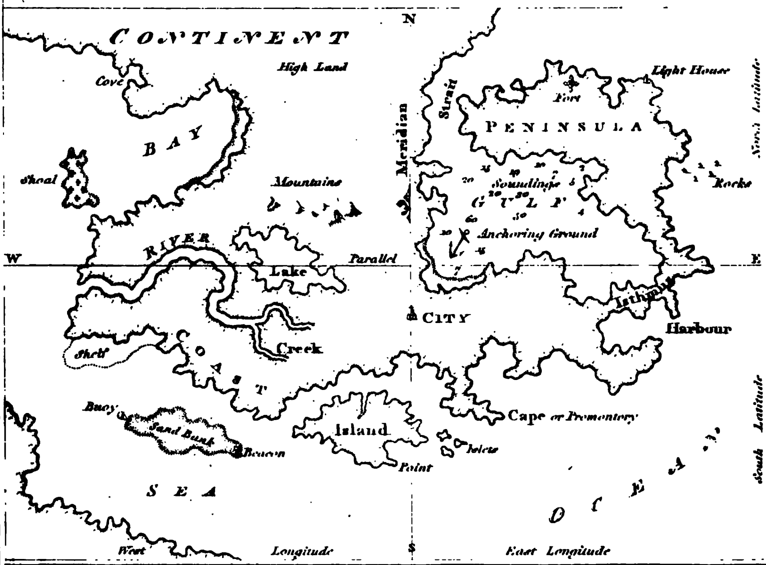
When the Sun or Stars come above the eaſternmoſt part of the Horizon, they are ſaid to riſe; and when they deſcend the weſtern part, they are ſaid to ſet.

When a ſhip is under the Equator, both the poles are in the Horizon; and, in proportion as ſhe ſails towards either, or increaſes her latitude, that pole is ſeen proportionably above the Horizon, and the other diſappears as much: but when a ſhip is ſailing towards the Equator, or decreaſes her latitude, ſhe depreſſes the elevated pole; that is, its diſtance from the Horizon decreaſes; conſequently, the latitude of a place is always equal to the elevation of the pole above the Horizon.

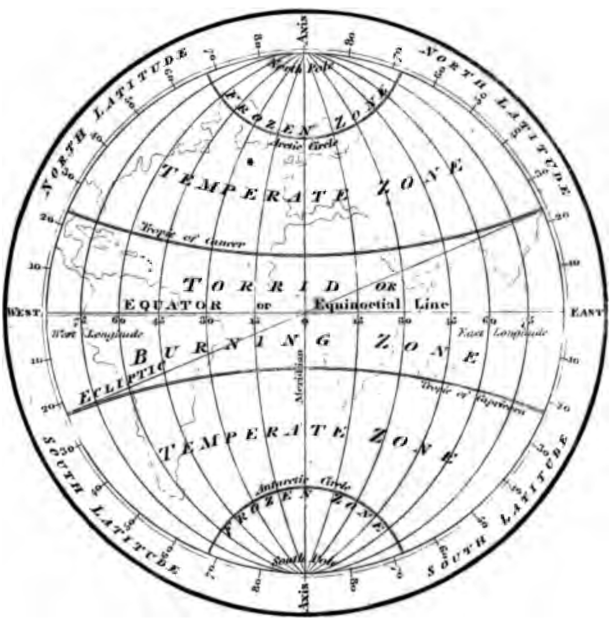
Note.——Here the Teacher will, perhaps, find it convenient to have a Globe, or Map of the World, before him, whereon he can point out the ſeveral Poſitions, Latitudes, Longitudes, &c. to the Pupil, as that will ſtrengthen his memory, and give him a better idea than he can poſſibly have by only reading them over. The ſame may be obſerved in reading the uſe of Gunter's Scale and the Quadrant.

This

EXPLANATION OF GEOGRAPHICAL TERMS.



THE CIRCLES, ZONES, &c. OF THE



ARTIFICIAL SPHERE OR GLOBE.

R. Fenny sculp.

Published by Wilkinson & the rest of the Pro...

This circle is represented by the Mariner's Compass, divided into 32 points or rhumbs, each 11° 15′.

The Tropics are two circles parallel to the Equator, and distant from it 23 degrees, 28 minutes; that on the north side of it is called the Tropic of Cancer, at which the sun has its greatest north declination; then making to us, and all places in north latitude, the longest day and shortest night, which is about the twenty-first of June. The other, on the south side, is called the Tropic of Capricorn, at which the sun has its greatest south declination, making then our shortest day and longest night, which is about the 22d of December.

The Polar Circles are also parallel to the Equator, compassing the poles of the world at 23 degrees, 28 minutes distance; that about the North Pole is called the Arctic Circle, and the other is called the Antarctic Circle.

These Tropics and Polar Circles divide the globe of the earth into 5 parts, called Zones, of which 3 were accounted by the Ancients to be so intemperate as to be uninhabitable; the Zones are called Torrid, Frigid, and Temperate; that is, 1 Torrid or Burning Zone, 2 Temperate, and 2 Frigid or Frozen Zones.

The Torrid Zone is all that space of the earth and sea which lies between the Tropics of Cancer and Capricorn, and is near 47 degrees broad: its inhabitants see the shadow of the sun turn sometimes towards one pole, and sometimes towards the other.

The two temperate Zones are those spaces of the earth and sea contained between each Tropic and the Polar Circles; the inhabitants of the North Temperate Zone have their shadows at noon fall north, and those of the South Temperate Zone have their shadows at noon fall south.

The two Frigid Zones are contained between each Polar Circle and its pole; those who inhabit them have their shadow always running round them, according to the different motions of the sun.

Climates are those tracts of the earth bounded by imaginary lines running parallel to the Equator, and of such a breadth, from south to north, that the length of the artificial day in one surpasses that in the other by half an hour.

The inhabitants of the earth are distinguished by the several meridians and parallels under which they live, and are denominated either Periæci, Antiæci, or Antipodes.

The Periæci are those people of the earth who live under the same parallels, but opposite meridians.

The Antiæci are those people of the earth who live under the same meridians, but opposite parallels.

The Antipodes are situated directly opposite to each other, the feet of the one directly against the feet of the other, lying under opposite parallels, and opposite meridians. It is midnight with one when

when it is noon day with the other; the longeſt day with the one is the ſhorteſt with the other; the length of the day with the one is equal to the other's night; and the ſeaſons are oppoſite, being ſummer with one, when it is winter with the other.

The Real Parts are earth and water, generally divided into four parts or quarters, called Europe, Aſia, Africa, and America; each of theſe, and conſequently the whole Globe, is divided into continents, iſlands, ſeas, &c.

A Continent is a great quantity of land, not divided by the ſea, wherein are ſeveral empires, kingdoms, and countries conjoined, as Europe, Aſia, and Africa, is one Continent, and America another.

An Iſland is a part of the earth that is environed or encompaſſed round by the ſea, as Great Britain and Ireland.

A Peninſula is a part of land almoſt ſurrounded with water, ſave one narrow neck of land which joins the ſame to the Continent.

An Iſthmus is a narrow neck of land joining the Peninſula to the Continent, by which the people may paſs from one to the other.

A Promontory is a high part of land, ſtretching itſelf into the ſea, the extremity of which is called a Cape or Headland.

A Mountain is a riſing part of dry land, over-topping the adjacent country, and appearing firſt at a diſtance.

The Earth being encompaſſed by water, whoſe waſhings, in ſurrounding the dry land, cut and ſhape many winding bays, creeks, and meandering inlets, and extending itſelf round them all, is but one continued ocean.

An Ocean is a vaſt collection of ſalt water, ſeparating Continents from one another, and waſhing their borders or ſhores.

A Sea is part of the Ocean, to which we muſt ſail through ſome Strait, as the Mediterranean and Baltic Seas.

A Strait is a narrow part of the ocean, lying between two ſhores, and opening a way into ſome ſea, as the Straits of Gibraltar, that lead into the Mediterranean Sea, and the Sound, which leads into the Baltic Sea.

A Creek or Cove is a ſmall narrow part of the ſea or river, that goes up but a little way into the land.

A Bay is a great inlet of the land, as the Bay of Biſcay, and the Bay of Mexico; otherwiſe a Bay is a ſtation or road for ſhips to anchor in.

A River is a conſiderable ſtream of water, iſſuing out of one or various ſprings, and continually gliding along till it diſcharges itſelf into the Sea. The leſſer ſtreams are called Rivulets.

A Lake is that which continually retains and keeps water in it, as the Lake Zair, in Africa, and Nicaragua, in America.

A Gulph is a part of the Ocean or Sea, contained between two ſhores,

ſhores, and is every where environed by land, except its entrance, where it communicates with other bays, ſeas, or oceans.

There are five Oceans, namely, the Northern, the Atlantic, the Pacific, the Indian, and the Southern.

The Atlantic Ocean is uſually divided into two parts, one called the North Atlantic Ocean, and the other the South Atlantic or Ethiopic Ocean.

The Northern Ocean ſtretches to the northward of Europe, Aſia, and America, towards the north pole.

The Atlantic Ocean lies between the Continents of Europe and Africa on the eaſt, and America on the weſt.

That part of the North Atlantic Ocean lying between Europe and America is frequently called the Weſtern Ocean.

The Pacific Ocean, or, as it is ſometimes called, the South Sea, is bounded by the weſtern and north-weſt ſhores of America, and by the eaſtern and north-eaſt ſhores of Aſia.

The Indian Ocean waſhes the ſhores of the eaſtern coaſts of Africa, and the ſouth of Aſia, and is bounded on the eaſt by the Indian iſlands and the ſouthern continent.

The Southern Ocean extends to the ſouthward of Africa and America towards the ſouth pole.

ABBREVIATIONS.

Alt. Altitude—A. M. before Noon—App. Apparent.

AR. Right Aſcenſion—Amp. Amplitude—Aug. Augmentation—Comp. Complement.

Col. Column—Cor. Correction—Cou. Courſe—Dec. Declination—Dep. Departure.

Dia. Diameter—Diſt. Diſtance—Diff. Difference—Dip. Depreſſion of the Horizon—Ela. Elapſed.

Equ. Equation—Equa. Equator—Hor. Horizon—Lat. Latitude—Log. or L. Logarithm.

L. L. Lower Limb——Mag. Magnetic—Mer. Meridian—Merid. Meridional—Mid. Middle.

Nat. Natural—Nau. Alm. Nautical Almanac—Obſ. Obſerved or Obſervation—Par. Parallel.

Parx. Parallax—Perp. Perpendicular—Pol. Polar—Pro. or P. Proportional—P. M. before Noon.

Ref. Refraction—Rad. or R. Radius—L. R. Logarithm Ratio.—Semi Dia. Half the Diameter.

U. L. Upper Limb—Zen. Zenith.

NAVIGATION.

THE great end and bufinefs of Navigation is to inftruct the Mariner how to conduct a fhip through the wide and pathlefs ocean, to the remoteft parts of the world, the fafeft and fhorteft way, in paffages navigable.

For the due and regular performance of which are requifite— A perfect knowledge of the figure and motion of the earth, the various real and imaginary lines upon it, fo as to be able to afcertain the real diftance and fituation of places with refpect to one another, with the ufe of the feveral inftruments made ufe of in meafuring the fhip's way; fuch as the log. half-minute glafs, quadrant, or fextant, to take the altitude of the fun and ftars; compafs, to reprefent the fenfible horizon; and azimuth compafs, to take the azimuth or amplitude of the fun, in order to know the variation of the magnetic needle; maps and charts of the feas and lands, together with the depth of water, the times and fettings of the tides upon the coafts he may have occafion to approach near; a competent knowledge of currents; of the mould and trim of the fhip, and the fail fhe bears, that fo due allowance may be made for leeway: by help of thefe, and fkill in the navigator, he may know at all times the place the fhip is in, which way he muft fteer, and how far, to gain his intended port.

Notwithftanding what has been faid, it may not be improper here to obferve, that

As latitude is counted from the equator upon an arch of the meridian, north and fouth, the difference of latitude between two places, both north, or both fouth, is found by fubtracting the lefs latitude from the greater; but if one latitude be north and the other fouth, the fum is the difference of latitude.

Confequently, if a fhip in north latitude fails northerly, or in fouth latitude foutherly, fhe increafes her latitude; but in north latitude failing foutherly, or in fouth latitude failing northerly, fhe decreafes her latitude; becaufe fhe fails nearer to the equator, from whence the latitude is reckoned.

Wherefore in north latitude failing northerly, or in fouth latitude failing foutherly, the difference of latitude, added to the latitude left, gives the latitude in.

In north latitude, failing foutherly, or, in fouth latitude, failing northerly, the difference of latitude fubtracted from the latitude left, gives the latitude in.

When the latitude decreafes, and the difference of latitude is greater than the latitude failed from, fubtract the latitude left from the difference of latitude, the remainder will be the latitude in, and of a different name; for it is plain that the fhip has croffed the equator.

As

As the longitude is counted from the firſt meridian eaſt and weſt, until it comes to the oppoſite meridian, it cannot exceed 180 degrees.

The difference of longitude between two places, being both eaſt or weſt, is found by ſubtracting the leſs longitude from the greater; but if one be in eaſt longitude, and the other in weſt, their ſum is the difference of longitude.

Therefore in eaſt longitude ſailing eaſterly, or in weſt longitude ſailing weſterly, the difference of longitude added to the longitude left, gives the longitude in.

In eaſt longitude ſailing weſterly, or in weſt longitude ſailing eaſterly, the difference of longitude ſubtracted from the longitude left, gives the longitude in.

When a ſhip ſails eaſt or weſt, until ſhe paſſes the oppoſite meridian, or 180 degrees, ſhe changes her longitude, or comes into a longitude of a different name.

What has been ſaid will be rendered familiar to the learner by the following examples:

EXAM. I. What is the difference of latitude between London in latitude 51° 32′ N. and Rome in latitude 41° 54′ N.

	° ′
From London's lat.	51 . 32 N.
Subtract Rome's lat.	41 . 54 N.
Rem. the diff. of lat.	9 . 38 N.
	60
Diff. in miles —	578

EXAM. II. A ſhip from latitude 29° 17′ S. ſails ſouthward until her difference of latitude be 374 miles, what latitude is ſhe come to?

	° ′
Latitude ſailed from	29 . 17 S
Diff. of lat. 374÷60 =	6 . 14 S.
Lat. in	35 . 31 S.

EXAM. III. Required the difference of latitude between Cape Finiſterre and Cape Roque in South America?

	° ′
Cape Finiſterre's lat.	42 . 52 N,
Cape St. Roque's lat.	5 . 0 S.
Diff. of lat.	47 . 52
	60
Diff. Lat. in Miles	2872

EXAM. IV. A ſhip from latitude 8° 25′ N. ſails ſouth 600 miles, what latitude is ſhe in?

	° ′
From diff. of lat. 600 miles, ÷ 60 =	10 . 00 S.
Sub. lat. left —	8 . 25 N
Lat. in —	1 . 35 S.

In the laſt example it is plain, that as the difference of latitude is more than the latitude left, the ſhip muſt have croſſed the Equator, and conſequently come into ſouth latitude.

NOTE. When one of the places has no latitude, or is on the Equator, then the latitude of the other place is their difference of latitude.

EXAM. V. What is the difference of longitude between Cape Finiſterre and the eaſt point of Barbadoes?

	° ′
Cape Finiſterre's long.	9 17W.
Barbadoes long.	59 49W.
Diff. of long. -	50 32W.
	60
Diff. in miles -	3032

EXAM. VII. What is the difference of longitude between Barcelona and Liſbon?

	° ′
Barcelona's long.	2. 18 E.
Liſbon's long.	9. 7 W.
Diff. of long. —	11.25 W.

EXAM. IX. What is the difference of longitude between the N. E. point of Japan and St. Chriſtopher's.

	° ′
N. E. of Japan's long.	140 . 25 E.
St. Chriſtopher's long.	62 . 42 W.
Exceeds 180° 00′	203 . 07
	360 . 00
Diff. of long. —	156.53 W.

EXAM. VI. A ſhip from Cape Charles, in Virginia, ſails weſtward till her difference of longitude be 400 miles, what longitude is ſhe in?

	° ′
Cape Charles's long	76 . 15W.
Diff. of long. 400 miles=	6 . 40W.
Long. in —	82 . 55W.

EXAM. VIII. A ſhip from 15° 40′ E. long. ſails weſtward till her diff. of long. be 27° 15′, what long. is ſhe in?

	° ′
Long. left	15 . 40 E.
Diff. of long.	27 . 15W.
Long. in —	11 . 35W.

EXAM. X. A ſhip from longitude 160° 20′ W. ſails weſtward until ſhe differs her long. 41° 20′, what long. is ſhe in?

	° ′
Long. left —	160 . 20W.
Diff. of long. —	41 . 20W.
	201 . 40
	360 . 00
Long. in —	158 . 20E.

Here it is plain, that the ſhip has croſſed the oppoſite meridian, and, therefore, has come into a longitude of a different name.

In ſailing due north or ſouth, the ſhip changes her latitude only; and ſailing eaſt or weſt, her longitude; but ſailing upon any other courſe, ſhe muſt change both latitude and longitude.

Eaſting or weſting, in Plane Sailing, is called Departure or Meridian Diſtance.

The inſtrument uſed in meaſuring a ſhip's way at ſea, is the Log.

Ships at ſea are directed from one place to another by means of an inſtrument called the Mariner's Compaſs, which is an artificial repreſentation of the horizon of every place, by the means of a circular piece of paper, called a card, divided like the horizon into degrees and points, which are called Rhumbs. Now the card being properly fixed to a piece of ſteel, called the Needle, that has been touched with a loadſtone, (whoſe property is ſuch as to cauſe one end of the needle ſo touched to point towards the north, when turning freely on ſomething ſupporting it) all the points of the card will be directed towards the correſponding points of the horizon:

Hence

A TABLE of DEGREES, and MINUTES,

To every Quarter Point of the Compass.

RTH	SOUTH	H.M	Points	° ′ ″	Points	H.M	SOUTH	NORTH
		0 11	0 ¼	2 . 48 . 45	0 ¼	11 49		
		0 22	0 ½	5 . 37 . 30	0 ½	11 37		
		0 34	0 ¾	8 . 26 . 15	0 ¾	11 26		
by E	S by W	0 45	1	11 . 15 . 0	1	11 15	S by E	N by W
		0 56	1 ¼	14 . 3 . 45	1 ¼	11 4		
		1 7	1 ½	16 . 52 . 30	1 ½	10 52		
		1 19	1 ¾	19 . 41 . 15	1 ¾	10 41		
N.E	S.S.W	1 30	2	22 . 30 . 0	2	10 30	S.S.E	N.N.W
		1 41	2 ¼	25 . 18 . 45	2 ¼	10 19		
		1 52	2 ½	28 . 7 . 30	2 ½	10 7		
		2 4	2 ¾	30 . 56 . 15	2 ¾	9 56		
.by N	SW by S	2 15	3	33 . 45 . 0	3	9 45	SE by S	NW by N
		2 26	3 ¼	36 . 33 . 45	3 ¼	9 34		
		2 37	3 ½	39 . 22 . 30	3 ½	9 22		
		2 49	3 ¾	42 . 11 . 15	3 ¾	9 11		
E	S W	3 0	4	45 . 0 . 0	4	9 0	S E	N W
		3 11	4 ¼	47 . 48 . 45	4 ¼	8 49		
		3 22	4 ½	50 . 37 . 30	4 ½	8 37		
		3 31	4 ¾	53 . 26 . 15	4 ¾	8 26		
.by E	SW by W	3 45	5	56 . 15 . 0	5	8 15	SE by E	NW by W
		3 56	5 ¼	59 . 3 . 45	5 ¼	8 4		
		4 7	5 ½	61 . 52 . 30	5 ½	7 52		
		4 18	5 ¾	64 . 41 . 15	5 ¾	7 41		
N.E	W.S.W	4 30	6	67 . 30 . 0	6	7 30	E.S.E	W.N.W
		4 41	6 ¼	70 . 18 . 45	6 ¼	7 19		
		4 52	6 ½	73 . 7 . 30	6 ½	7 7		
		5 4	6 ¾	75 . 56 . 15	6 ¾	6 56		
by N	W by S	5 15	7	78 . 45 . 0	7	6 45	E by S	W by N
		5 26	7 ¼	81 . 33 . 45	7 ¼	6 34		
		5 37	7 ½	84 . 22 . 30	7 ½	6 22		
		5 49	7 ¾	87 . 11 . 15	7 ¾	6 11		
ast	West	6 0	8	90 . 0 . 0	8	6 0	East	West

R.Pouncy sculp.

Published by J. Johnson & the rest of the Proprietors July 1, 1806.

Hence it follows, that in every place the north point of the card ſhews the poſition of the meridian of that place, and ſome one rhumb or point of the card will coincide with, or be directed along the track that makes any given angle with the meridian; conſequently, by the help of the card or compaſs, a ſhip may be kept in any propoſed track or courſe.

A rhumb line, or point, is a right line drawn from the centre of the compaſs to the horizon, and is named from that point of the horizon it falls in with.

The courſe is the angle which any rhumb line makes with the meridian, and is ſometimes reckoned in degrees, and ſometimes in points of the compaſs; ſo that if a ſhip ſails upon the ſecond rhumb, or N. N. E. the courſe is 22 degrees 30 minutes: and ſo for any other.

One Magnus, a ſhepherd, firſt diſcovered the loadſtone by its ſticking to the iron of his ſandals; whence the name Magnet was given to the ſtone, or Magnetic Needle. Gio, of Naples, about 300 years ago, firſt diſcovered that a piece of iron rubbed on it, and then ſuſpended, had the property of pointing to the north and ſouth, and thence applied it to navigation.

How to touch the Compaſs Needle.

Having two ſtrong magnetical bars, lay the compaſs needle as nearly north and ſouth as you can, with the intended north northward; join the two magnets in a line conſiderably above the needle, the north end of which being northward (round which end of each a notch is made) bring them down upon the needle, that the junction may be on its centre; then draw them aſunder along on each half of the needle, and continue the motion till they are eight inches clear of the needle's end, and, by a circular motion, join them, and bring them to the centre as before, then ſeparate them, repeating the operation ſeven or eight times, taking care not to put the magnets out of their paralleliſm, and the needle will be ſufficiently magnetical.

PLANE SAILING.

PLANE SAILING is the art of navigating a ſhip upon principles deduced from the notion of the earth's being an extended Plane, and is no more than the application of Plane Trigonometry to the ſolution of the ſeveral variations, or caſes; where the hypothenuſe, or longeſt ſide, is always the rhumb that the ſhip ſails upon.

The perpendicular is the difference of latitude counted on the meridian, and the baſe the departure: which is eaſting or weſting, counted from the meridian.

The

The angle oppofite the bafe is the courfe or angle that the fhip makes with the meridian; and the angle oppofite the perpendicular is the complement of the courfe, which being taken together, make always eight points or rhumbs, which is 90 degrees.

In contructing figures relating to a fhip's courfe, let the upper part, on what the figure is drawn upon, always reprefent the north; the lower part fouth; the right hand eaft; and the left weft.

Draw the north and fouth line to reprefent the meridian of the place the fhip fails from; then, if the fhip's courfe is to be fouthward, take the upper end of the line for the place failed from; but, if the courfe is northward, take the lower end for that place.

When the courfe is eafterly, defcribe the arch, and lay off the courfe and departure on the right-hand fide of the meridian; but when wefterly, on the left-hand fide.

When the courfe is given in degrees, the degrees expreffing it muft be taken from the line of chords; but when in points, from the line of rhumbs; and is always to be laid off upon the arch, beginning at the meridian.

When the courfe is given in points, it may be fet down with its correfponding logarithm in the calculation, as found in Table III. of the logarithms, without reducing it into degrees.

In all cafes, wherever the complement of the courfe, or co-fine, &c. is ufed, the degrees or points put down is the courfe itfelf; yet the logarithm belonging to the complement, or co-fine, &c. of that courfe is taken.

CASE I.

Courfe and Diftance failed given, to find the Difference of Latitude and Departure from the Meridian.

A fhip from the Lizard, in lat. 49° 57′ N. fails S. W. by W. 488 miles.

Required the latitude fhe is in, and her departure from the meridian fhe failed from?

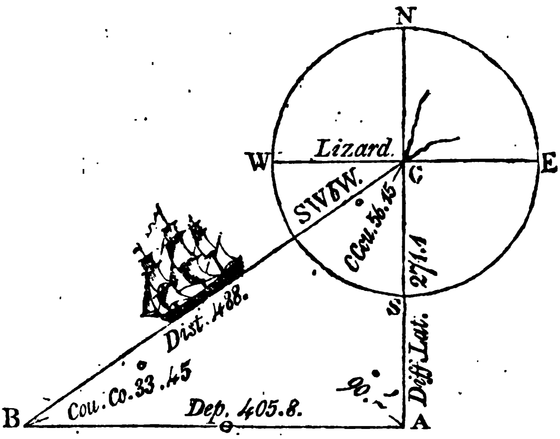
By CONSTRUCTION.

Draw the line CA to reprefent the meridian of the Lizard, and C the Lizard point.

With the chord of 60° in your compaffes, and one foot in C, defcribe the compafs N. W. S. E.

Take 5 points in your compaffes from the line of rhumbs on the plane fcale, and fet it off on the arch from S. towards W. for the courfe; draw the line CB, which make equal to the dift. 488; draw BA parallel to E. and W. to cut the meridian in A.

Then will AC be the difference of latitude 271,1, and AB the departue 405,8.



By making the Diſtance Radius, it will be by Axiom I.

The courſe 5 points=56° 15′
To find the Departure.

As radius 90°	0.00000
Is to the diſt. 488	2.68842
So is the ſine cou. 5 pts.	9.91985
To the dep. 405,8	2.60827

The com. courſe 3 points 33° 45′
To find the Diff. of Latitude.

As radius 90°	0.00000
Is to the diſt. 488	2.68842
So is co-ſine cou. 5 pts.	9.74474
To the diff. of lat. 271	2.43316

Now as the ſhip is in north latitude ſailing ſoutherly from the latitude left — — 49° 57′ N.
Take the diff. of lat. 271,1÷60= 4 31 S.

Gives the lat. in 45 26 N.

And the departure from the meridian is 405,8 miles.

To render the following work more eaſy, and that the Learner, by being initiated in this other method, will be the better able to underſtand many things in the following work, (as well as in ſeveral modern authors,) where the proportion of oppoſite ſides, and oppoſite angles, do not appear, and where radius is not introduced.

Obſerve.—In the deſcription of the logarithm (p. 22) you are ſhewn, that by adding the logarithm of two numbers together, their ſum produces the ſame number in the logarithms, as the product of the ſame two numbers when multiplied. And by ſubtracting the logarithm of two numbers from each other, the remaining logarithm produces the ſame number as the quotient of the ſame number; or the complement arithmetic (p. 28) of the loga-

rithm

rithm of the divisor added to the logarithm of the dividend, rejecting (radius) or 10 in the index (p. 35) the result is the very same. Again, when the proportion begins with a sine or a co-sine, the complement arithmetic added to the other two terms, their sum rejecting, 10 in the index will be the logarithm of the number sought.

Now as the logarithm co-secant of any angle is equal to the complement arithmetic of the logarithm sine of that angle, and the logarithm secant is equal to the arithmetic complement of the logarithm co-sine of that angle: omitting radius, therefore, the co-ar. may be taken out of the tables by inspection.

Here all the three sides may be made radius, to find the difference of latitude and departure; therefore, the Learner may make which side he pleases radius; but as for my part I shall make the first, where the distance is made radius, whenever the course is given.

Though this method of working by logarithms is certain, yet the same may be wrought by Gunter's Scale and Compasses, and by several other methods.

Note.—When the course is given in points, make use of the line marked sine rhumbs, and tang. rhum. on the upper side of the scale; when in degrees, make use of the lines marked sine and tang.

By GUNTER.

Now to perform the last case, extend from rad. or 8 points to 5 points on the line marked SR; that extent will reach from the dist. 488 to the dep. 405,8 on the line of num.

2dly. ' Extend from rad. or 8 points to 3 points (the comp. of the cou. on the line SR;) that extent will reach from the dist. 488 to the diff of lat. 271 on the line of numbers.

Thus may all the operations be performed in the several cases of Navigation.

By this case is calculated the Table of Latitude and Departure for every degree, point, and quarter point of the Mariner's Compass, to the dist. of 300 miles, which is of excellent use in working day's works at sea, and may be applied both to middle latitude and Mercator's sailing, as shall be shewn hereafter; we shall only proceed now to the working of the last case by the Table of Diff. of Latitude and Departure.

By INSPECTION.

Find the given cou. at the top or bottom of the tables, either among the points or degrees, and in that page, and right against the dist. taken in its column, stand the diff of lat. and dep. in their columns.

Thus the cou. is S. W. by W. or five points, which is found at the bottom of the Table of Diff. of Lat. and Dep. for points: and as the dist. 488 is too great to be found in the Tables, divide it by 2 (or any

any other convenient number) and that gives 244, which look for in the dift. column, and right againft it ftands 135,5 for the diff. of lat. and 202,8 for the dep. which being doubled (becaufe divided by 2) gives 271 for the diff. of lat. and 405,6 for the dep. the fame as before. Any of thefe methods will do, but the laft is chiefly practifed at fea.

NOTE.—All points or degrees above 45, are to be looked for at bottom of Table I. and all lefs at top; and the miles on the left hand.

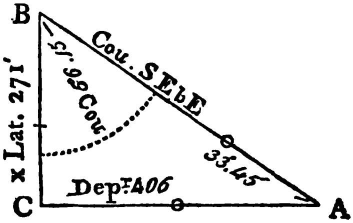
CASE II.

Courfe and Difference of Latitude given, to find the Diftance run, and Departure from the Meridian.

If a fhip runs S. E. by E. from 1° 45′ north latitude, and then by obfervation is in 2° 46′ fouth latitude, what is her diftance, and departure.

Now, in this cafe, as the fhip has croffed the Equator, therefore the lat. 1° 45′ N. added to 2° 46′ S. is 4° 31′, which multiplied by 60 gives 271 miles for the diff. of lat.

Conftructed the fame as Problem X. in Geometry. Draw BC=271, and BA making an angle with BC=5 points, or 56° 15′; upon C erect the perp. CA to join BA in A and it is done; then will CA=406, and AB=488.



By CALCULATION.

By making the Diftance AB Radius, it will be,

Courfe S. E. by E. 5 pts.=56° 15′		Complement 3 points=33° 45′	
To find the Departure.		To find the Diftance.	
As cofine cou. 5 pts. co. ar.	0.25526	A co-fine cou. 5 pts-co. ar.	0.25526
Is to the diff. of lat. 271	2.43297	Is to the diff. of lat. 271	2.43297
So is fine cou. 5 points	9.91985	So is rad.	10.00000
To the dep. 405.6	2.60808	To the dift- 487.8	2.68823

Hence the fhip's dift. run is 487,8 miles, and her dep. from the merid. is 405,6 eafterly.

By GUNTER.

'Extend from 3 to 5 points on the line marked SR, that extent will reach from the diff. of lat. 271 to the dep. 405,6 on the line of numbers.'

2dly. 'Extend from rad. or 8 points to 3 points, that extent will reach from the diff of lat. 271 to the dift. 488 on the line of numbers.'

By INSPECTION.

Find the cou. among the points or degrees, and the diff. of lat. in its column, right against which stand the dist. and dep. in their columns.

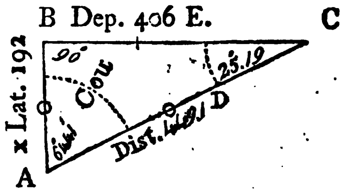
Now as the diff. of lat. 271 is too great to be found in the Tables, I divide it by 2, and that gives 135,5 which I find over five points in the lat. column; against that stands 244, for the dist. and 202,8 for the dep. which multiplied by 2 gives the dist. 488, and the dep. 405.6.

CASE III.

Course and Departure from the Meridian given, to find the Distance and Difference of Latitude.

If a ship sails N. E. by E. ¾ E. from a port in 3° 15′ south latitude, until she depart from her first meridian 406 miles, I demand her distance, and what latitude she is in?

By CONSTRUCTION.



Draw the mer. AB, upon which erect the perp. BC, and set off thereon from B her dep. 406 easterly from B to C, with the chord of 60°, on C describe an arch, and set off thereon the comp. of the cou. as DE, and through D and C draw the line CDA, cutting the mer. in the point A; then the dist. AC, measured on the same scale before used, gives 449, and AB 192 the diff. of lat.

By CALCULATION.

By making the Distance AC radius, it will be,

The course 5¾ points=64° 41′		The compl. 2¼ points=25° 19′	
To find the Diff. of Lat.		To find the Distance.	
As sine cou. 5¾ pts. co. ar.	0.04384	As sine cou. 5¾ pts. co. ar.	0.04384
Is to the dep. 406	2.60853	Is to the dep. 406	2.60853
So is co-sine cou. 5¾ pts.	9.63099	So is rad.	10.00000
To the diff. of lat. 192	2.28336	To the dist. 449.1	2.65237

From the lat. left — —	3°	15′	S.
Subtract the diff. of lat. 192 miles, or —	3	12	N.
The remainder being 3, shews the ship is in	0	03	S.

By GUNTER.

'Extend from 5¾ points to 2¼ on the line marked SR, that extent will reach from the dep. 406 to the diff. of lat. 192 on the line of numbers.'

2dly.

2dly. ‘ Extend from rad. to $5\frac{3}{4}$ points, that extent will reach from the dep. 406 to the dift. 449 miles.’

By INSPECTION.

Find the cou. either among the points or degrees, and the dep. in its column ; right againft which ftands the dift. and diff. of lat. in their refpective columns.

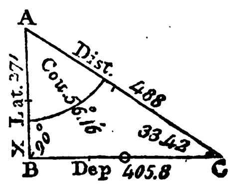
Thus, with the cou. $5\frac{3}{4}$ points, and half the dep. I find 224,5 for the dift. and 95,8 for the diff. of lat. which being doubled, gives the dift. 449, and the diff of lat. 191,6 nearly as before.

CASE IV.

Diftance and Difference of Latitude given, to find the Courfe and Departure.

Suppofe a fhip fails 488 miles, between the fouth and the eaft, from a port in 2° 52′ fouth latitude, and then by obfervation is in 7° 23′ fouth latitude ; what courfe has fhe fteered, and what departure has fhe made ?

From the latitude by obfervation 7° 23′ take 2° 52′ the latitude left, the remainder 4° 31′ multiply by 60=271 miles or minutes of difference of latitude.



Conftructed as Problem XI. in Geometry.

Draw the mer. AB=271 ; upon B erect the perp. BC ; take 488 in your compaffes, and with one foot on A, lay the other on the line BC ; join A and C ; then will B C be the dep. 406, and the angle B A C the cou.=56° 16′, or 5 points nearly.

To find the Courfe.		To find the Departure.	
At the dift. 488 co. ar.	7.31158	As rad.	10.00000
Is to the rad.	10.00000	Is to the dift. 488	2.68842
So is the diff. lat. 271	2.43297	So is fine cou. 56° 16′	9.91993
To co-fine cou. 56° 16′	9.74455	To the dep. 405.8	2.60835

Hence the cou. is S. E. by E. and the dep. 405,8.

By GUNTER.

‘ The extent, from the dift. 488 to the diff. of lat. 271, on the line of numb. will reach from rad. or 90°, to 33° 44′ the co-cou. on the line of fines.

‘ And the extent, from rad. to 56° 16′ on the line of fines, will reach from the dift. 488 to the dep. 405,8 on the line of numbers.’

By

By INSPECTION.

Seek in the Tables till againſt the diſt. taken in its column be found the given diff. of lat. in one of the following columns; and adjoining to it ſtands the dep. which, if leſs than the diff. of lat. the cou. is found at the top; but, if greater, the cou. is found at the bottom.

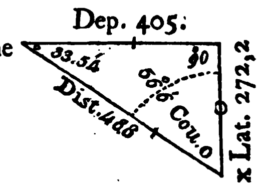
Now, with half the diſt. 244, and half the diff. of lat. 135,5 look in the Tables till they are found to agree in their reſpective columns, which they do nearly over 5 points; againſt them ſtands 202,8 for the dep. which, being doubled, gives 405,6 nearly, as before.

CASE V.

Diſtance and Departure given, to find the Courſe and Difference of Latitude.

Admit a ſhip ſails 488 miles between the north and weſt from the iſland of Bermuda, in lat. 32° 35′ north, until her dep. is 405 miles; what courſe has ſhe ſteered, and what lat is ſhe in?

NOTE. This caſe is conſtructed much the ſame as the laſt.



By CALCULATION.

To find the Courſe.		To find the Diff. of Lat.	
As the diſt. 488 co ar.	7.31158	As radius	10.00000
Is to radius	10.00000	Is to the diſt. 488	2.68842
So is dep. 405	2.60746	So is co-ſine co. 56° 6′	9.74644
To the ſine of cou. 56° 6′	9.91904	To the diff. of lat. 272,2	2.43486

Hence the courſe is N. 56° 6′ W. or N. W. by W. nearly.

To the lat. ſailed from 32° 35′ add the diff. of lat. 272, or 4° 32′, gives 37° 07′, the lat. the ſhip is in.

By GUNTER.

'Extend from the diſt. 488 to the dep. 405 on the line of numbers, that extent will reach from rad. to the cou. 56° 6′ on the line of ſines.

2dly. 'Extend from rad. to the comp. of the cou. 33° 54′ on the line of ſines, that extent will reach from the diſt. 488 to the diff. of lat. 272 on the line of numbers.

By INSPECTION.

Seek in the Tables till againſt the diſt. taken in its column, be found the given dep. in one of the following columns; and adjoining

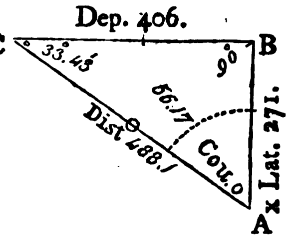
joining to it ftands the diff. of lat. which, if greater than the dep. the cou. is found at the top; but if lefs, the cou. is found at the bottom.

Now, with half the dift. 244, and half the dep. 202,5, I look in the Tables, and find them to agree in their columns, nearly over 5 points, againft which is lat. 135,5, which being doubled, is 271, the diff. of lat. nearly, as before.

CASE VI.

Difference of Latitude and Departure given, to find the Courfe and Diftance.

A fhip fails between the north and weft till her difference of latitude is 271 miles, and her dep. is 406 miles; I demand her courfe and diftance?



Conftructed as Problem XII. in Geometry.

Draw AB=271, and perp. to it BC =406; join C and A; then will the angle CAB be the cou. =56° 17', and AC the dift. =488 miles.

To find the Courfe.		To find the Diftance.	
As the diff. of lat. 271 co ar.	7.56703	As fin.-cou 56° 17' co ar.	0.07998
Is to rad.	10.00000	: Dep. 406	2.60873
So is the dep. 406	2.60853	: : Rad.	10.00000
To the tan. of cou. 56° 17'	10.17556	: Dift. 488.1	2.68851

Hence her cou. is N. 56° 17' W. or N. W. by W. and the dift. failed 488,1 miles.

By GUNTER.

'Extend from the diff. of lat. 271 to the dep. 406 on the line of num. that extent will reach from rad. to 56° 17' the cou. on the line of tan.

2dly. 'For the dift. we muft confider it as rad. (there being no line of fec. on the fcale) and extend from rad. or 90° to the cou. 5 points on the line of fines, that extent will reach from the dep. 406, to the dift. 488 on the line of numbers.

By INSPECTION.

Seek in the Tables till half the given diff. of lat. 135,5, and dep. 203 are found together in their refpective columns; then right againft them will be found half the dift. 244, in its column, and the cou. ftand in degrees either at the top or bottom of the column where the diff. of lat. and dep. was found, which in this cafe is over 56° 15', or 5 points the cou. required.

The fix foregoing Problems are the common cafe of Plane Sailing,

ing, which the learner ought to be well acquainted with; and for that end I here add six more for practice, whose answers may be found by the foregoing rules:

Question I. A ship in 2° 10′ south lat. sails N. by E. 89 leagues: what lat. is she in, and what is her dep.?

Answer. Lat. in 2° 12′ N. and dep. 17.36 leagues.

Question II. A ship sails S. S. W. from a port in 41° 30′ north lat. and then by observation the said ship is in 36° 57′ north lat. I demand the dist. run and dep.?

Answer. Dist. run 98,5 leagues, dep. 37,7 leagues.

Question III. A ship sails S. S. W. half W. from a port 2° 30′ south lat. until her dep. be 59 leagues; I demand her dist. run and lat. in?

Answer. Dist. run 125,2 leagues, lat. in 8° 1′ south.

Question IV. If a ship sails 360 miles south westward from 21° 59′ south lat. until by observation she be in 24° 49′ south lat. what is her cou. and dep.?

Answer. The cou. is S. W. by W. half W. or S. 61° 47′ W. and her dep. from the mer. is 317,3 miles.

Question V. Suppose a ship sails 354 miles north eastward from 2° 9′ south lat. until her dep. be 150 miles; what is her cou. and lat. in?

Answer. Her cou. is N. 25° 4′ E. or N. N. E. half E. nearly, and she is in lat. 3° 11′ North.

Question VI. Sailing between the north and the west, from a port in 1° 59′ south lat. and then arriving at another port in 4° 8′ north lat. which is 209 miles to the westward of the first port; I demand the cou. and dist. from the first port to the second?

Answer. The cou. is N. 29° 40′ W. or N. N.W. ¼ W. nearly; and the dist. of the ports is 422,3 miles, or 140,7 leagues.

TRAVERSE SAILING.

HAVING learned those necessary problems concerning a Single Course, the next is a Compound Course, commonly called a Traverse; in order to the right understanding of which, observe the following definitions:

A Traverse is when a ship, meeting with contrary winds, sails on several courses.

When the wind is directly or partly against a ship's direct course to the place she is bound to, she reaches her port by a kind of Z like course; which is made by sailing with the wind, first on one side of the ship, and then on the other side.

In a ship, when looking towards the stem, head, or fore-part;

Starboard signifies the right-hand side;

Larboard or Port the left-hand side;

Aft

Aft or abaft is towards the hinder part, or ftern;

The Beam fignifies athwart or acrofs the middle of the fhip.

When the fhip fails the fame way the wind blows, fhe is faid to fail or run before the wind; and the wind is right aft, or right aftern; and her courfe is then 16 points from the wind.

When a fhip fails with the wind blowing directly acrofs her, fhe is faid to have the wind on the beam; and her courfe is eight points from the wind.

When the wind blows obliquely acrofs the fhip, the wind is faid to be abaft the beam, or afore the beam, according as her courfe is more or lefs than 8 points from the wind.

When a fhip endeavours to fail towards that part of the compafs from whence the wind blows, fhe is faid to fail on a wind, or to ply to windward, or clofe-hauled, or on a bowling.

A veffel failing as near as fhe can to the point from whence the wind blows, is faid to be clofe hauled. The generality of fhips will lie within about 6 points of the wind, but floops and other veffels will lie much nearer.

The Windward, or Weather-fide, is that fide of the fhip on which the wind blows; and the other is called the Leeward or Lee-fide.

Tacks and fheets are large ropes made faft to the lower corners of the fore and main fails, by which either of thefe corners are hauled fore and aft.

When a fhip fails by or on a wind, the windward tacks are always hauled forwards, and leeward, or lee-fheets aft.

The ftarboard tacks are aboard when the ftarboard fide is to windward, and the larboard to leeward; and the larboard tacks are aboard when the larboard fide is to windward, and the ftarboard to leeward, either tacks the yards are braced up.

To know how near the wind a fhip will lie, obferve the courfe fhe goes on each tack when fhe is clofe hauled, then half the number of points between the two courfes will fhew how near the wind that fhip will lie.

The moft common cafes, in turning to windward, may be conftructed by the following precepts:—

Having drawn the meridian, or north and fouth, and parallel of latitude (or eaft and weft line) in a circle, reprefenting the horizon of the place, mark, in the circumference, the place of the wind; draw the rhumb, paffing through the place bound to, and lay thereon the diftance of that place from the centre.

On each fide of the wind lay off in the circumference the points or degrees fhewing how near the wind the fhip can lie, and draw the rhumbs.

Now, the firft courfe will be on one of thofe rhumbs, according to the tack the fhip leads with; draw a line through the place bound to, parallel to the other point, to meet with the firft, and this will fhew the courfe and diftance on the other tack.

To

To resolve a Traverse, is to reduce and bring several courses into one; the courses are known by the compass, and the distance by the log, which in common voyages is hove once in two hours, but in ships of war, or in East-Indiamen, every hour.

In the steerage, or some convenient place in the ship, there is generally kept a table, called the log-board, divided into seven columns; in the first is written the hours of the day, in the second, the knots the ship runs during half a minute; each of these knots bear the same proportion to a sea mile that half a minute does to an hour; consequently, so many knots as the ship runs in half a minute, (the time allowed for trying the experiment) so many miles she runs in an hour. In the third the fathoms, 10 of which ought to make a knot; in the fourth the courses steered by the compass; in the fifth the winds; in the sixth the lee-way, or how far the ship is drove to the leeward of the course steered by the compass; in the seventh the transactions of the day, as in the following Table. Every day at noon the contents are transcribed into the log-book, which is divided into columns, exactly like the log-board, and the several courses being corrected by allowing for the lee-way and variations, and the distance run upon each being set down in a Traverse-table, shews what difference of latitude and departure the ship has made during the last 24 hours; and from thence is found the latitude and longitude the ship is in, &c. This operation is called doing a day's work.

The LOG-BOARD.

H.	K.	F.	Courses.	Winds.	Lee-way.	Transactions.
2	6		S. W. by S.	N.		
4	5	5				
6	5			N. W.		
8	5					Moderate gales
10	4	5	N. E.	N. N. W.		& fair weather,
12	4	5				at 8 A. M. saw
2	4	5				a ship to the
4	4	5				northward.
6	4	5				
8	5		S. W. by S.	W. N. W.		
10	4	5				No observa-
12	4					tion.

Having placed the several courses and distances run upon each, begin with the first course S. W. by S. which is 3 points, and the distance run upon it being summed up, is 21,5, or an half, which being doubled (because the log is hove every two hours) is 43. In like

like manner proceed with the other courſes, and then find the diff. of lat. and dep. for each cou. and diſt.

When the cou. is to the ſouthward, the diff. of lat. muſt be ſet in the column marked S, but if to the northward, in that marked N; likewiſe, when the courſe is to the eaſtward, the dep. muſt be ſet in the column marked E; but if to the weſtward, in that marked W. Thus the firſt courſe being S. W. by S. 3 points, the diff. of lat. belonging to it is ſet under S. and the dep. under W. as in the following table:—

TRAVERSE TABLE.

COURSES.	DIST.	N.	S.	E.	W.
S. W. by. S.	43		35,8		23,9
N. E.	45	31,8		31,8	
S. W. by S.	27		22,4		15,0
		31,8	58,2	31,8	38,9
			31,8		31,8
		D. Lat.	26,4 S.	Dep. W.	7,1

Here the weſtings being greater than the eaſtings, the diff. ſhews how far the ſhip has got to the weſtward; and the ſouthings being greater than the northings ſhew how far ſhe is got to the ſouthward of the place ſhe ſet out from.

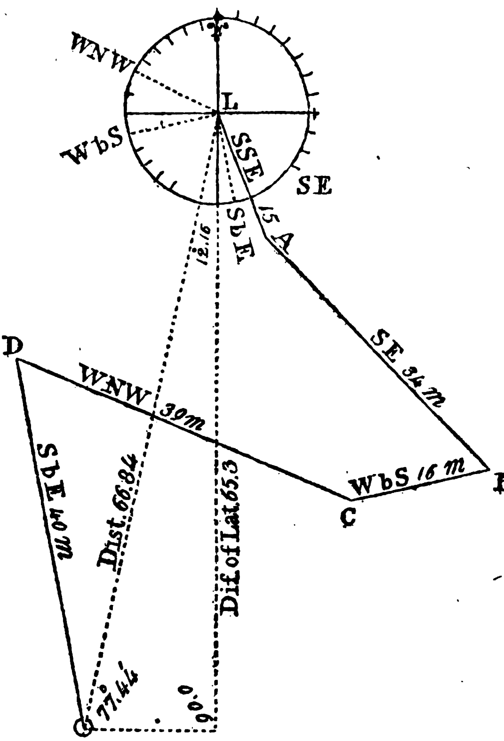
Now the diff. of lat. 26,4 and dep. 7,1 being looked for in the Tables, will be found nearly ſtanding together under 15° and againſt diſt. 27. Hence the courſe made good upon the ſeveral courſes is S. 15° W. and the diſt 27 miles.

I EXAMPLE

EXAMPLE I.

Suppoſe a ſhip takes her departure from the Lizard in latitude 49° 57′ N. it bearing N. N. W. diſtance, by eſtimation, 5 leagues, ſails S. E. 34, W. by S. 16, W. N. W. 39, and S. by E. 40 miles; required the latitude ſhe is in, and her bearing and diſtance from the Lizard?

By CONSTRUCTION.



E Dep. 14,2 M

Draw the line L M to repreſent the meridian of the Lizard, and L the Lizard point; on L deſcribe the compaſs; then ſet off the oppoſite point to the bearing of the Lizard; the S. S. E. line L A, which make equal to 15 miles; parallel to the S. E, line draw the line AB equal to 34 miles; again, from B parallel to W. by S. draw BC equal to 16 miles; next, through C, draw a line parallel to W, N. W. which make equal to 39 miles; from D draw DE, parallel to the S. by E. line, equal to 40 miles; then is E the place of the ſhip at the end of her ſeveral courſes, EL the diſtance, LM the diff. of lat. EM her departure, and the angle ELM the courſe ſhe has made good.

To

To find the fame by CALCULATION.

For the Firft Courfe, S. S. E. 15 Miles.

To find the Diff. of Lat.		For Departure.	
As rad. 90°	10.00000	As rad. 90°	10.00000
Is to dift. 15	1.17609	Is to dift. 15	1.17609
So is co-fine cou. 2 pts.	9.96562	So is fine cou. 2 pts.	9.58284
To diff. lat. 13,9	1.14171	To dep. 5,7	0.75893

Second Courfe S. E. 34 Miles.

For Difference of Latitude.		For Departure.	
As rad 90°	10.00000	As rad. 90°	10.00000
Is to co fine cou. 45°	9.84948	Is to fine cou. 45°	9 84948
So is dift. 34	1.53148	So is dift. 34	1.53148
To diff. lat. 24	1.38096	To dep. 24	1.38096

Third Courfe W. by S. 16 Miles.

For Difference of Latitude.		For Departure.	
As rad. 90°	10.00000	As rad. 90°	10.00000
Is to co-fine cou. 78° 45′	9.29024	Is to fine cou. 78° 45′	9.99157
So is dift. 16	1.20412	So is dift. 16	1.20412
To diff. lat. 3,1	0.49436	To dep. 15,7	1.19569

Fourth Courfe W. N. W. 39 Miles.

For Difference of Latitude.		For Departure.	
As rad. 90°	10.00000	As rad. 90°	10.00000
Is to co-fine cou. 67° 30′	9.58284	Is to fine cou. 67° 30′	9.96562
So is dift. 39	1.59106	So is dift. 39	1.59106
To diff. lat. 14,9	1.17390	To dep. 36	1.55668

Fifth Courfe S. by E. 40 Miles.

For Difference of Latitude.		For Departure.	
As rad. 90°	10.00000	As rad. 90°	10.00000
Is to co-fine cou. 11° 15′	9.99157	Is to fine cou. 11° 15′	9.29024
So is dift. 40	1.60206	So is the dift. 40	1.60206
To diff. lat. 39,2	1.59363	To the dep. 7,8	0.89230

Though this method of finding the diff. of lat. and dep. by logarithms is certain, yet the fame may be more readily found by the Tables of Diff. of Lat. and Dep.; that is, to find the diff. of lat.

 and

and dep. for each courſe and diſt. by inſpection, and placing them down as in the following TRAVERSE TABLE :—

COURSES.	DIST.	DIFF. LAT.		DEPARTURE.	
		N.	S.	E.	W.
S. S. E.	15		13,9	5,7	
S. E.	34		24,0	24,0	
W. by S.	16		3,1		15,7
W. N. W.	39	14,9			36,0
S. by E.	40		39,2	7,8	
From ſum	—	14,9	80,2	37,5	51,7
Take	—	—	14,9		37,5
Reſts		—	65,3		14,2

Having placed them as above, add up all the weſtings, eaſtings, northings, and ſouthings ſeparately, and ſet down their reſpective ſums at the bottom of each column; and as the weſting is greater than the eaſting, ſubtract the eaſting therefrom, and the diff. 14,2 ſhews that the ſhip's dep. is ſo much weſt of her firſt meridian.

Again, the ſouthing being greater than the northing, ſubtract the northing from it, and the remainder ſhews how far the ſhip is to the ſouthward of her firſt place, or diff. of lat. ſhe has made.

To find the direct Courſe or Bearing of the Lizard from the Ship.

As the diff. lat. 65,3 co. ar.		8.18509
Is to rad. 90°		10.00000
So is the dep. 14,2		1.15229
To tang. cou. 12° 16′		9.33738

Which, becauſe the diff. of lat. is ſoutherly, and the dep. weſterly, is S. 12° 16′ W. Whence the Lizard bears from the ſhip N. 12° 16′ E. or N. by E. and 1° 1′ E.

To find the direct Diſtance.

As ſine of cou. 12°16′ co. ar.	0.67272
Is to the dep. 14,2	1.15229
So is rad. 90°	10.00000
To the diſt. 66,84	1.82501

The cou. and diſt. may be found ſufficiently near under 12 degrees in Tables, where the diſt. is 67 miles.

EXAMPLE II.

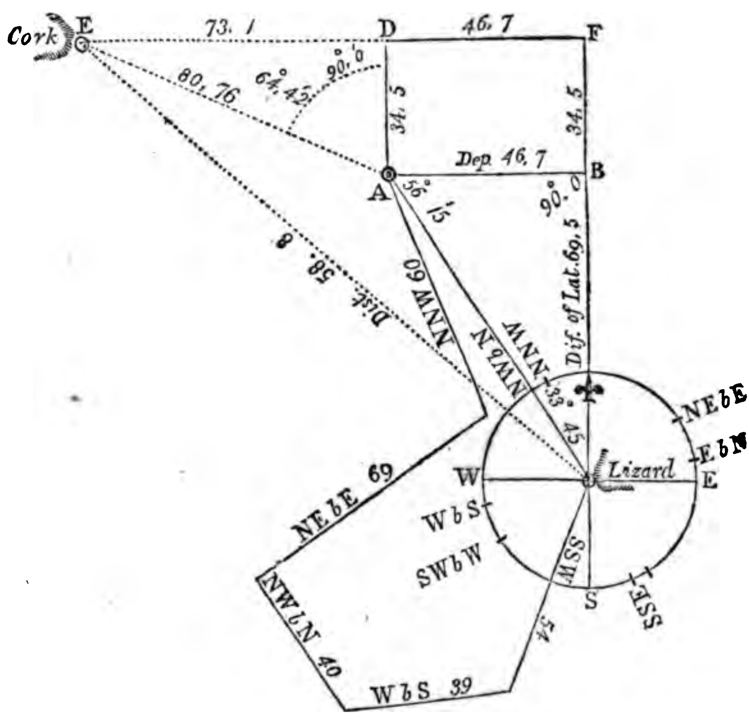
Suppoſe a ſhip from the Lizard 49° 57′ is bound to Cork in lat. 51° 41′ N. whoſe dep. from the mer. of the Lizard is 120 miles weſt, but by reaſon of contrary winds is obliged to ſail on the following courſes, viz. S. S. W. 54 miles, W. by S. 39, N. W. by N. 40,

N. 40, N. E. by E. 69, and N. N. W. 60 miles; I demand the direct cou. dist. diff of lat. and dep. made good upon the several courses, with the lat. she is in, and what course she must afterwards steer, and how far, to gain her intended port?

By PROJECTION.

Latitude of Cork	—	51° 41′
Latitude of Lizard	—	49 57
		1 44

Difference of latitude........ 104 Departure 120



With the chord of 60° describe a circle, through which draw the mer. north and south, and, crossing that at right angles, draw the east and west points; the centre represents the Lizard; then set off two points from the south westerly; through which draw a line to the centre for the first cou. S. S. W. upon that set off the first dist. run 54 miles, which is the ship's place at the end of her first course.

Draw the W. by S. rhumb; and parallel to it a line, passing through the ship's last place; and upon it set off 39 for the second dist.; draw the N. W. by N. rhumb; and parallel to it, as before, draw

draw a line, paſſing through the ſhip's laſt place; upon it ſet off 40, and that will be the place of the ſhip at the end of her third cou.; then draw the N. E. by E. rhumb; and parallel to it a line, paſſing through the ſhip's laſt place; and upon it ſet off 69 for the fourth diſt.; then draw a N. N. W. rhumb; and parallel to it a line as before, through the ſhip's laſt place; and upon it ſet off the laſt diſt. 60, which is the ſhip's place at the end of her ſeveral courſes; from which draw a line parallel to the eaſt and weſt line, until it cuts the mer.; for the whole dep. from this to the centre, being meaſured on the ſame ſcale, will give her diff. of lat. made good upon the ſeveral courſes; and a line drawn from the ſhip's laſt place to her firſt, will give the whole diſt.; and the angle which this line makes with the meridian will be the ſhip's courſe made good.

Now, to find what courſe ſhe muſt ſteer, and how far ſhe muſt run, from the centre of the compaſs, or the Lizard point, ſet off the whole diff. of lat. of the two ports, viz. 104, to F; through F draw an E. and W. line weſterly, and ſet off thereon the whole dep 120 from F to E; then will E repreſent the ſituation of Cork; join AE, and draw AD parallel to the mer.; then will AE be the diſt. ſhe has to run to her intended port, the angle EAD is the cou. ſhe muſt ſteer, ED is how far ſhe is to the eaſtward of it, and AD is how far to the ſouthward of it.

By CALCULATION.

With the diff. of lat. and dep. between the two ports, to find their bearings and diſtances.

To find the Bearing.		To find the Diſtances.	
As diff. of lat. 104 co. ar.	7.98297	As ſine cou. 49° 5′ co. ar.	0.12167
Is to rad. 90°	10.00000	Is to dep. 120	2.07918
So is whole dep. 120	2.07918	Is to rad. 90°	10.00000
To tan. cou. 49° 5′	10.06215	To diſt. 158,8	2.20085

Whence the bearing between the Lizard and Cork is N. 49° 5′ W. diſt. 159 miles. Or with inſpection to be 49°, and diſt. 159 miles; and the ſeveral courſes and diſtances being found, will ſtand as in the following

TRAVERSE

TRAVERSE TABLE.

COURSES.	DIST.	DIFF. LAT.		DEPARTURE.	
		N.	S.	E.	W.
S. S. W.	54	....	49.9	....	20.7
W. by S.	39	....	7.6	....	38.3
N. W. by N.	40	33.3	....	....	22.
N. E. by E.	69	38.3	....	57.4	....
N. N. W.	60	55.4	....	....	23.
From		127.0	57.5	57.4	104.0
Take		57.5	....	....	57.4
Remains		69 5	....	....	46.6

To find her direct Course and Distance made good.

To find the Course.			To find the Dist.		
As diff. of lat. 69,5 co. ar.		8.15802	As rad.		10.00000
Is to rad.	90°	10.00000	To diff. lat.	69.5	1 84198
So is dep.	46,6	1.668339	So is sec. cou. 33° 51′		10 08066
To tan. cou. 33°.51′		9.82641	To dist. 83,68		1.92264

Or, with the proper diff. of lat. 69,5 and the dep. 46 6, look in the tables of diff. of lat. and dep. the nearest numbers corresponding to these are 69,6 and 47 under 34° against dist. 84.

To find the Bearing and Distance to the intended Port.

	° ′	In Angle A E D.	
Lizard's lat.	49 . 57 N.	From whose diff. lat. ports	104
Add diff. lat.	1 .9 N.	Subtract ship's northing	69 . 5
Ship's latitude in	51 . 6 N.	Remains ship southw. of port	34 5

From whole Dep. subtract Ship's Dep. 120—47=73 L D.

As diff. of lat. 34.5 co ar.		8.56218	As sine cou. 64° 42′ co. ar.		0.04379
Is to rad. tan. 45°		10.00000	Is to dep.	73	1.86332
So is dep.	73	1,86332	So is rad.	90	10.00000
To tan. cou. 64°,42′.		10.32550	To dist.	80,76	1.90711

Whence the cou. she must steer is N. 64° 42′ W. or N. W. by W. ¼ W. dist. 81 miles.

Or, with the diff. of lat. 34, 5 and dep. 73, look into the Tables, the

the nearest num. to these are 73,4 and 34,2 standing over 65 against dist. 81.

All the preceding may be found by Gunter's Scale, but shall leave the working of them to exercise the Learner, who ought to be well acquainted with Traverse Sailing; and for that purpose it has been thought proper to subjoin the following, which is the most general and useful that well can be, and may be worked by any of the foregoing methods.

A ship being at sea in lat. 37° 10′ N. is bound to a port, which lies to the westward in lat. 33° 0′ N. the dep. between the ship and the place is 180 miles; consequently, by Case VI. the course will be S. W. by S. 2 degrees westerly, and dist. 308 miles, but the wind being variable, is obliged to ply upon these several courses, the dist. run upon each being obtained by the log; and the first she sails (with her larboard tacks on board) S. W. by W. 27 miles, W. S. W. half W. 30 miles, W. by S. 25 miles, W. by N. 18 miles.

(Starboard tacks on board wind shifting) S. S. E. 32 miles, S. S. E. three quarters E. 27 miles, S. by E. 25 miles, S. 31 miles, S. S. E. 39 miles

Required the lat. the ship is in, and her dep. from the mer. upon what course she must steer if possible, and how far she must sail to gain her intended port?

The diff. of lat. and dep. being found by the preceding directions, will stand as in the following Table:—

TRAVERSE TABLE.

COURSES.	DIST.	DIFF. OF LAT. N.	DIFF. OF LAT. S.	DEPARTURE. E.	DEPARTURE. W.
S. W. by W.	27		15,0		22,4
W. S. W. ½ W.	30		8,7		28,7
W. by S.	25		4,9		24,5
W. by N.	18	3,5			17,7
S. S. E.	32		29,6	12,2	
S. S. E. ¾ E.	27		23,2	13,9	
S. by E.	25		24,5	4,9	
South	31		31,0		
S. S. E.	39		36,0	14,9	
		3,5	172,9	45,9	93,3
			3,5		45,9
		Diff. Lat.	169,4 S	Depar.	47,4 W.

The

The ſhip is in lat. 34° 21′ N. the dep. is 47,4 W.

The cou. made good is S. 15° 38′ W. and diſt. 175,9.

The cou. to the intended port is S. 58° 35′ W. or S.W. by W. one quarter weſt nearly, diſtance 155,4.

MIDDLE LATITUDE SAILING.

IN Plane Sailing the earth was conſidered as a plane, repreſenting a bowling-green, having the meridians parallel to each other, and conſequently the degrees of longitude equal in all places; but this cannot be true, as the earth is a globe or ſphere; for,

As the meridians are circles on the terraqueous globe, meeting in the poles, (as may be ſeen in the Plate page 45) it is obvious, that any two of thoſe circles muſt recede more at greater diſtances from the poles; and at equal diſtances from each pole, or at the equator, the diſtance between the meridians is greateſt.

The true place of a ſhip at ſea depends upon its diſtance from the equator, and ſome noted meridian; and ſince the meridional diſtance, that is, the diſtance between any two meridians, varies in every latitude, it is therefore convenient this diſtance ſhould be reckoned in a fixed latitude, and where the degrees are of the ſame magnitude with thoſe of the meridian, which can be no where but on the equator, where 60 geographical miles make a degree.

The circumference of all circles are in direct proportion to each other, as their radii; and ſince the earth turns once round its axis in 24 hours, every point upon its ſurface muſt deſcribe circles parallel to the equator: hence it follows, that the circumference of any parallel of latitude, in miles, is to the circumference of the equator, in miles, as the co-ſine of that latitude is to radius; and, that the breadth of a degree, in any parallel of latitude, is to the breadth of a degree upon the equator, as the ſine complement of that latitude is to radius.

By the laſt proportion was the following Table calculated, which ſhews the breadth of a degree of longitude in every latitude; and may be made to anſwer for any degrees or minutes by taking proportional parts.

The following Table shews how many Miles answer to a ***Degree of Longitude*** *at every Degree of Latitude.*

D. L.	MILES.	D. L.	MILES.	D. L.	MILES.	D. L.	MILES.	D. L.	MILES.
1	59..99	19	56..73	37	47..92	55	34..41	73	17..54
2	59..96	20	56..38	38	47..38	56	33..55	74	16..53
3	59..92	21	56..01	39	46..62	57	32..68	75	15..52
4	59..86	22	55..63	40	45..95	58	31..79	76	14..51
5	59..77	23	55..23	41	45..28	59	33..90	77	13..50
6	59..67	24	54..81	42	44..59	60	30..00	78	12..48
7	59..56	25	54..38	43	43..88	61	29..19	79	11..45
8	59..42	26	53..9[illegible]	44	43..16	62	28..17	80	10..42
9	59..26	27	53..56	45	42..43	63	27..24	81	9..38
10	59..08	28	52..97	46	41..68	64	26..30	82	8..35
11	58..89	29	52..47	47	40..92	65	25..36	83	7..32
12	58..68	30	51..96	48	40..1[illegible]	66	24..[illegible]1	84	6..28
13	58..46	31	51..43	49	39..36	67	23..45	85	5..23
14	58..22	32	50..88	50	38..57	68	22..48	86	4..18
15	57..95	33	50..32	51	37..76	69	21..50	87	3..14
16	57..67	34	49..74	52	36..94	70	20..52	88	2..09
17	57..37	35	49..15	53	36..11	71	19..54	89	1..05
18	57..06	36	48..54	54	35..26	72	18..55		

Hence it follows, that

As radius, or sine 90°
Is to the diff. of long. in miles,
So is co-sine of any paral. of lat.
To the dist. in miles between any
Two mer. in that paral. of lat.

AND,

As co-sine of any paral. of lat.
Is to the distance run in miles
in that lat.
So is the radius, or sine of 90°
To the diff. of long. in miles.

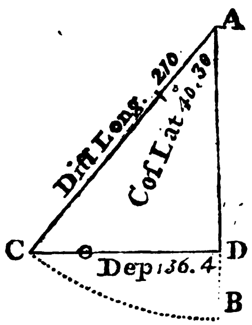
From what has been said, arises the solution of the following Problems.

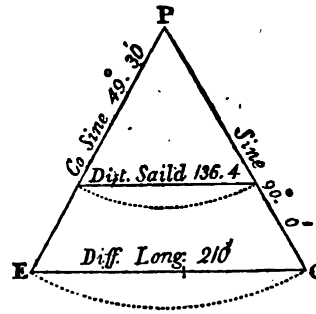
PROBLEM I.

The Difference of Longitude between two Places, both in one Parallel of Latitude, being given, to find the Distance between them.

Suppose a ship in the lat. 49° 30′ N. or S. sails directly E. or W. until her diff. of long. be 3° 30′, and the dist. sailed be required?

By





By PROJECTION.

With the ſine of 90° in your compaſſes, taken from the Plane Scale, and with one foot in P, deſcribe the arch EQ, and upon it, ſet off the diff. of long. 210 miles, and draw the lines PE and PQ to repreſent the two meridians; and then EQ repreſents the equator, and P the pole. Again, with the ſine com. of the lat. 49° 30′, *viz.* 40° 30′ in your compaſſes, taken from the line of ſines on the Plane Scale, and with one foot in P deſcribe an arch, and the diſt. between the points, where it cuts the two meridians, being meaſured upon the ſame ſcale of equal parts that the diff. of long. was, will be the dep. 136,4 miles.

Or, thus:—

Draw the mer. AB, and with the chord of 60 in your compaſſes deſcribe an arch, and upon it ſet off the comp. of the lat. 40° 30′ (taken from the line of chords) and ſet it off upon the arch as a cou. in Plane Sailing, and draw the line AC as a diſt. which make equal to the diff. of long. 210 miles; then will the departure CD be the diſtance 136,4 miles as before: this laſt method is preferable to the former, as we are not confined to any particular ſcale.

Reverſe this Problem, and ſuppoſe the diſt. ſailed in any parallel of lat. given, to find the diff. of long.

With the ſine com. of lat. in your compaſſes deſcribe an arch, upon which ſet off the dep. 136,4 miles, and through the points where it cuts the arch draw the lines PE and PQ; then, with the ſine of 90° in your compaſſes, and one foot in the former centre P, deſcribe an arch to cut PE and PQ; then EQ being meaſured upon the ſmall ſcale of equal parts that the dep. was, will be the diff. of long. 210 miles.

By CALCULATION.

To find the Departure.

As rad. 90° — —	10,00000
Is to the diff. of long. 210	2,32222
So is co-fine lat. 49° 30′	9,81254
To the dift. or dep. 136,4	2,13476

By GUNTER.

'The extent from rad. to fine com. lat. 40° 30′ on the line of fines, will reach from the diff. of long. 210 to the dift. 136,4 on the line of numbers.'

By INSPECTION.

Find the fine com. of the lat. among the degrees, and in the dift. column the diff. of long. oppofite to which, in the column of dep. is the dift. required; but as the co-lat. is 40° 30′, therefore,

For 40 degrees you will find —	135
For 41 degrees you will find —	137,7
The fum is — —	272,7
Half the dift. required —	136,3

This is done becaufe the Table of Diff. of Lat. and Dep. is calculated only for fingle degrees.

By the reverfe of the laft problem, having the dift. run in any parallel to find the diff. of long.

Suppofe a fhip in lat. 49° 30′ N. or S. fails directly E. or W. 136,4 miles, and her diff. of long. be required?

As co-fine of lat. 49° 30′ co. ar.	0,18746
Is to the dift. 136,4 —	2,13481
So is rad. — —	10,00000
To the diff. of long. 210 —	2,32227

By INSPECTION.

Look for the comp. of the lat. among the degs. as if it was a cou. and the dep. in its column; right againft which ftands the diff. of long. in the dift. column. In the laft Problem the fhip is fuppofed to have failed due eaft or weft, in the fame parallel of lat. but in her courfe fhe generally croffes feveral meridians and parallels, and then arrives at a different lat. from that fhe left; and, as it is plain by

by the foregoing Table, that the miles which make a degree in one parallel, will not be the fame as thofe that make a degree in any other parallel, lying on the fame fide of the equator; therefore add both lats. together, and take half their fum for a mean or mid. lat.; which may be conceived as if the fhip had failed in one lat.; with which the diff. of long. may be turned into dep. and dep. into diff. of long. in the fame manner as has been already fhewn, for it will be

As radius Is to the difference of longitude, So is the co-fine of the mid. lat. To the departure.	AND,	As the co-fine of the mid. lat. Is to the departure, So is radius To the difference of longitude.

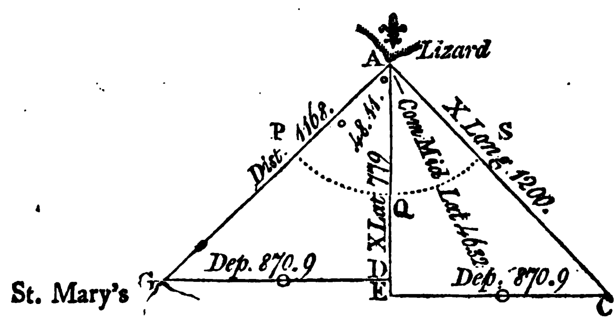
Having the diff. of lat. and dep. the cou. and dift. are found by Cafe the Sixth, in Plain Sailing.

CASE I.

Required the bearing and dift. between the Lizard, in lat. 49° 57′ N. long. 5° 12′ W. and the ifland of St. Mary, one of the Weftern iflands, in lat. 37° N. and long. 25° 12′ W?

Lizard's lat.	49° 57′ N.		49° 57′	Long.	5° 12′ W.
St. Mary's lat.	36 58 N.		36 58	Long.	25 12 W.
	12 59	Sum 2)	86 55		20 0
	60				60
		Mid. lat.	43 25		
Diff. in miles	779		90 00		1200 diff. long.
		Co-mid. lat.	46 32		

By PROJECTION.



Draw the mer. AE, with the chord of 60 defcribe the arch PS; upon which fet off 46° 32′, the comp. of mid. lat. from Q to S; through S draw the line AC = 1192, the diff. of long. let fall the perpendicular CE, which will be the dep. 865; upon AE fet off AD 777, the diff. of lat.; and upon D erect the perp. DG, and upon

upon it ſet off the dep. 865; join G and A, and it is done; for GA will be the diſt. 1168 miles, and the angle GAD the cou. S. 48° 4′ W.

The CALCULATION.

To find the Departure		To find the Courſe.	
As radius	10.00000	As diff. of lat. 779 co. ar.	7.10846
Is to diff of long. 1200	3.07918	Is to radius	10.00000
So is co ſine mid. lat. 43°28′	9.86080	So is dep. 870,9	2.93998
To the dep. 870,9	2.93998	To tang. of cou. 48° 11′	10.04844

To find the Diſtance.	
As ſine cou. 48° 11′ co. ar.	0.12768
Is to deg. 870,9	2.93998
So is radius 90°	0.00000
To the diſt. 1168	3.06766

NOTE. The courſe may be found without the departure, by Middle Latitude Sailing, thus:

As the diff. of lat. 779 co. ar.	7.10846
Is to the diff. long. 1200.	3.07918
So is co ſi. mid. lat. 43° 28′	9.86080
To tang. cou. 48° 11′	10,04844

By GUNTER.

1ſt. ‘ The extent from 46° 32′, the comp. of the mid. lat. to rad. on the line of ſines, will reach from 1200 to 870,9 on the line of numbers.

2dly. ‘ The extent from rad. or 90° to 41° 49′, the comp. of the cou. on the line of ſines, will reach from 779 to 1168 on the line of numbers.

3dly. ‘ The extent from 779 to 870,9 on the line of numbers, will reach from 45° to 48 on the line of tangents.’

By INSPECTION.

Look for the comp. of mid. lat. as if it was a cou. in Plane Sailing, and diff. of long. in the diſt. column; oppoſite to which ſtands the dep. in its column. Having the diff. of lat. and dep. the cou. and diſt. are found as in Caſe VI. in Plane Sailing.

Thus, taking $\frac{1}{4}$ of the diff. of long. 1200=300, and as the comp. of the mid. lat. is 46° 32′, or nearly 46½, I look over 46 and 47, and againſt the diſt. ſtands 215,8 and 219,4 in the dep. columns; which, added together, gives 435,2, half is 217,6; this multiplied by 4 gives 870,4 the dep.

Again, taking $\frac{1}{4}$ the diff of lat. and $\frac{1}{4}$ of the dep. 194,7, and 217,6; the neareſt number to theſe ſtanding together are 216,2 and 194,7 over 48° and againſt the diſt. 292; this, multiplied by 4, gives 1168 miles: hence the cou. is S. 48° W.; and diſtance 1168.

CASE

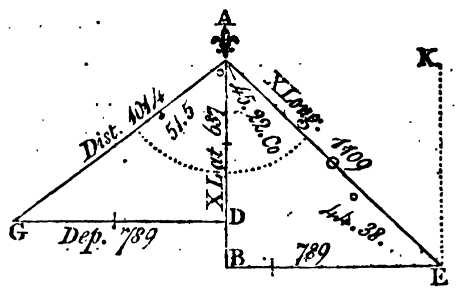
CASE II.

Both Latitudes and Departure from the Meridian given, to find the Course aud Distance, and Difference of Longitude.

A ſhip in lat. 49° 57′ N. and long. 5° 24′ W. ſails ſouth weſterly, till her dep. is 789 miles, and ſhe be in lat. 39° 20′ N.; I demand the cou. diſt. and long. ſhe is in?

Latitude left	49°	57′ N.
Latitude in	39	20 N.
Diff. of latitude	10	37
	60	
In miles	637	

Latitude left	49°	57′ N.
Latitude in	39	20 N.
Sum of latitude	89	17
Middle latitude	44	38
	90	00
Comp. of mid. lat.	45	22



By PROJECTION.

Draw the mer. AD, from A to D, ſet off the diff. of lat. 637 miles, and on D erect the perp. DG, which make equal to the dep. 789 miles. Draw the line AG, and that will be the diſt. 1014 miles, and the angle DAG the cou. 51° 5′.

Again, draw EK parallel to AD, making the diſt. from AD equal to the dep. DG 789, on A deſcribe an arch; take the comp. of the mid. lat. 45° 22′ in your compaſſes from the line of chords, and ſet that off on the arch on the oppoſite ſide of the mer. AD, through where that cuts the arch draw the line AE to cut the line KE in E, from E let fall the perp. EB, and it is done; for AE will be the diff. of long. 1109 miles.

By CALCULATION.

To find the Courſe it will be,		To find the Diſtance it will be,	
As the diff. of lat. 637 co. ar.	7.19586	As the ſine cou. 51° 5′ co. ar.	0.10899
Is to radius 90°	10.00000	Is to the dep. 789	2.89708
So is dep. 789	2.89708	So is radius 90°	10.00000
To tan. cou. 51° 5′	10.09294	To the diſt. 1014	3.00607

To

To find the Difference of Longitude it will be,

As co fine mid. lat. 44° 38' co. ar.	0.14775
Is to departure 789 — —	2.89708
So is radius 90 — —	10.00000
To diff. of long. 1109	3.04483
Long. the ship failed from	5° 24' W.
Diff. long. 1109 miles, or ÷60=	18 29 W.
Longitude in —	23 53 W.

By GUNTER.

1ft. 'The extent from the diff. of lat. 637 to the dep. 789 on the line of numbers, will reach from rad. or 45° backward to 51° 5', the cou. on the line of tangents.

2dly. 'The extent from 51° 5' to radius or 90° on the line of fines, will reach from the dep. 789 to the dift. 1014 on the line of numbers.

3dly, 'The extent from the comp. of mid. lat. 45° 22' to rad. or 90° on the line of fines, will reach from the dep. 789, to the diff. of long. 1109 on the line of numbers.'

By INSPECTION.

RULE. With the diff. of lat. and dep. find the cou. and dift. as in Cafe VI. in Plane Sailing.

2dly. Taking the comp. of mid. lat. as a cou. and the dep. in its column, and the dift correfponding to thefe will be the diff. of long.

Thus, taking a tenth of the diff. of lat. 637, and dep. 789, that is, 63,7 and 78,9, the neareft numbers to thefe are 63,6 and 78,5 ftanding together over 51°, againft the dift. 101, which multiplied by 10 gives 1010; hence the cou. by infpection, is S. 51° W. and the dift. 1010.

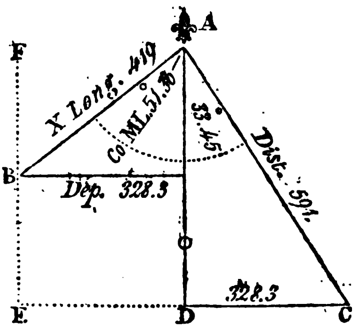
Taking 45° 22' or 45° as a cou. and a tenth of the dep. 78,9 in its column, the neareft is 78,5, in the dift column ftands 111, which multiplied by 10 gives 1110 for the diff. of long. nearly, as before.

CASE III.

One Latitude, Courfe and Diftance given, to find the Difference of Latitude and Difference of Longitude.

A fhip in latitude 42° 30' N. and longitude 18° 31' W. fails S. E. by S. 591 miles; or 197 leagues; I demand the latitude and longitude the fhip is in?

By



By PROJECTION.

As Caſe I. in Plane Sailing, viz. Draw the mer. AD, and on A deſcribe an arch with the chord of 60°, and upon it ſet off the courſe S. E. by S. or 3 points, through where that cuts the arch draw the line AC; making it equal to the diſt. 591, from C let fall the perp. CD; then will CD be the dep. and AD the diff. of lat. 491 miles.

Draw the line EF parallel to AD, making the diſt. from it equal to the dep.

Take the comp. of mid. lat. 51° 36′ from the line of chords in your compaſſes, and ſet it off on the arch on the other ſide of the mer. AD, and through where that cuts the arch draw the line AB to cut the line EF in B, from B let fall a perp. and it is done; for AB will be the diff. of long. 419 miles.

Lat. left	42° 30′ N.	Mid. lat.	38 24		
Diff. of lat.	8 11 S.	Com. mid. lat.	51 36		
Lat. in	34 19 N.	Long. left	18° 31′ W.		
Lat. left	42 30	Diff. of long.	6 59 E.		
Sum	2)76 49	Long. in	11 32 W.		

From what has been ſaid, it will be eaſy to conſtruct any of the following caſes, as they are conſtructed the ſame as in Plane Sailing: only obſerving that to find the diff. of long. you muſt take the comp. of mid. lat. as a courſe in Plane Sailing; with this cou, and the dep. find the diſt. and that will be the diff. of long.

To find the ſame by CALCULATION.

To find the Diff. of Latitude.		To find the Departure.	
As rad. 90°	10.00000	As rad. 90°	10.00000
Is to the diſtance 591	2.77159	Is to the diſtance 591	2.77159
So is co-ſine courſe 3 pts.	9.91985	So is ſine courſe 3 pts.	9.74474
To the diff. of lat. 491,4	2.69144	To the dep. 328,3	2.51633

To find the Difference of Longitude.

Without the Departure it will be,		With the Departure it will be,	
As co fi.m.lat.38°24'co.ar.	0.10585	As co fi.m.lat.38°24'co.ar.	0.10585
Is to fine courfe 3 pts.	9.74474	Is to the dep. 328,3	2.51627
So is diftance 591	2.77159	So is rad. 90°	10.00000
To diff.of long.419=8° 11'	2.62218	To diff. of long 419=6°59'	2.62212
		Long. left	18 31 W.

Whence the fhip is in lat. 34° 19' N. and long. 11 32 W.

By GUNTER.

1ft. ' The extent from rad. or 8 points, to the comp. of the cou. 5 points on the line marked SR will reach from the dift. 591 to 491, the diff. of lat. on the line of numbers.

2dly. ' The extent from rad. or 8 points to the cou. 3 points on the line SR will reach from the dift. 591 to the dep. 328 on the line of numbers.

3dly. ' The extent from the fine comp. mid. lat. 51° 36' to rad. or 90° on the line of fines, will reach from the dep. 328 to the diff. of long. 419 on the line of numbers.'

By INSPECTION.

RULE. With the cou. and dift. find the diff. of lat. and dep. as in Cafe I. in Plane Sailing.

2dly. Take the comp. of mid. lat. as a cou. and the dep. in its column, and againft it in the dift. column ftands the diff. of long.

Thus, under the cou. 3 points, and againft a tenth of the dift. 591=59, ftand 49,1 and 32,8; thefe, multiplied by 10, give 491 for the diff. of lat. and 328 for the dep.

Now, taking the comp. mid lat. 51° 36' or 51° as a cou. and a tenth of the dep. 328=32,8 in its column, (the neareft is 32,6), againft which ftands 42 in the dift. column; this multiplied by 10 gives 420, the diff. of long. nearly, as before.

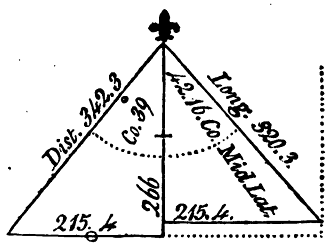
If the foregoing directions be well underftood, the Learner will not find it difficult to work the following cafes in Mid. Lat. Sailing.

CASE IV.

Courfe and Difference of Latitude given, to find the Departure, Diftance, and Difference of Longitude.

Suppofe a fhip failing from the Lizard, makes, when the variation, lee-way, &c. are allowed for, her courfe S. 39° W. or S. W. by S. half wefterly, and then, by obfervation, is in lat. 45° 31' N.; what is her dift. run, and long. in?

Lat.



Lat. of the Lizard	49° 57′ N.	——		49° 57′ N.
Lat. by observation	45 31 N.	——		45 31 N.
Diff. of lat.	4 26 S.	Sum of latitudes		95 28
	60	Mid. lat		47 44
In miles	266	Co-mid. lat.		42 16

By CALCULATION.

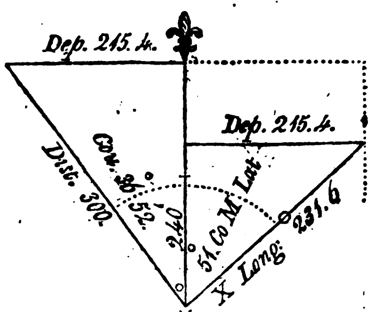
To find the Departure it will be,		To find the Distance it will be,	
As co-sine cou. 39° co. ar.	0.10950	As the co-si. cou. 39° co. ar.	0.10950
Is to the diff. of lat. 266	2.42488	Is to the diff. of lat. 266	2.42488
So is the sine cou. 39°	9.79887	So is rad. 90°	10.00000
To the dep. 215,4	2.33325	To the dist. 342,3	2.53438

To find the Diff. of Longitude.		To find the Longitude in.	
As co-si. of mid. lat. 47°44′ co. ar.	0.17225	Lizard's long.	5° 12′ W.
Is to the dep. 215,4	2.33325	Diff. of lon. 320 miles or	5 20 W.
So is rad. 90°	10.00000	Long. in	10 32 W.
To the diff. of long. 320,3	2.50550		

CASE V.

Both Latitudes and Distance given, to find the Course and Difference of Longitude.

Suppose a ship runs 300 miles N. westerly, from 37° N. lat. and long. 10° 25′ W. until she be in lat. 41° N.; what is her cou. and long. in?



Lat. left.	—	37° 00′ N.	—		37° 00′ N.
Lat. in	—	41 00 N.	—		41 00 N.
Diff. of lat.		4 00 N.	Sum of lat.		78 00
		60	Mid. lat.		39 00
In miles	—	240	Co-mid. lat.		51 00

By CALCULATION.

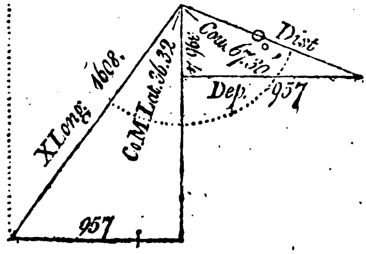
To find the Course it will be,		To find the Dif. of Lon. it will be,	
As the dist. 300 co. ar.	7.52288	As co-si. mid. lat. 39° co. ar.	0.10950
Is to rad. 90°	10.00000	Is to tang. cou. 36, 52	9.87501
So is diff. of lat. 240	2.38021	So is diff. of lat. 240	2.38021
To the co-sine cou. 36° 52′	9.90309	To d. lon. 231,6 = 3° 52′ W.	2.36472

Longitude left	—	—	10°. 25′ W.
Longitude in	—	—	14 . 17 W.

CASE VI.

One Latitude, Course, and Departure given, to find the Distance, Difference of Latitude, and Difference of Longitude.

A ship sails E. S. E. from the latitude 50° 10′ S. and longitude 10° 16′ E. until her departure from the meridian be 957 miles; I demand her distance sailed, and the latitude and longitude she is in?



To

To find the Difference of Latitude it will be,			
As sine cou. 6 pts. co. ar.	0.03438	Lat. left	50°. 10′ S.
Is to the dep. 957	2.98091	Diff. of lat. 396, or	6 . 36 S.
So is co-sine cou. 6 pts.	9.58284	Lat. in	56°. 46′ S.
To the diff. of lat. 396,4	2.59813		

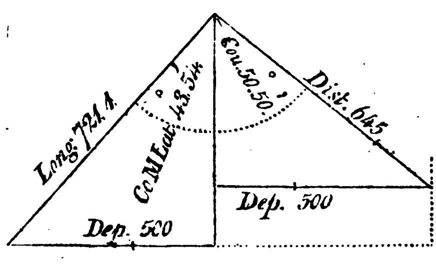
To find the Distance it will be,			
As sine cou. 6 pts. co. ar.	0.03438	Lat. left	50°. 10′ S.
Is to the departure 957	2.98091	Lat. in	56 . 46
So is radius	10.00000	Sum is	2)106 . 56
To the distance 1036	3.01529	Mid. lat.	53 . 28
		Co-mid. lat.	36 . 32

To find Diff. of Long. it will be,			
As co-si.m.lat.53°28′co.ar.	0.22527	Long. left is	10 . 16 E.
Is to the departure 957	2.98091	Diff. of long. 1608, or	26 . 48 E.
So is radius	10.00000	Longitude in	37 . 4 E.
To mer. diff. of lon. 1608	3.20618		

CASE VII.

One Latitude, Distance sailed, and Departure from the Meridian given, to find the Course, Difference of Latitude, and Difference of Longitude.

A ship in latitude 49° 30′ N. and longitude 24° 40′ W. sails south eastward 645 miles, until her departure from the meridian be 500 miles: I demand the course steered, and the latitude and longitude the ship is in?



To find the Course it will be,		To find the Diff. of Lat. it will be,	
As the dist. 645 co. ar.	7.19044	As radius	10.00000
Is to the radius	10.00000	Is to the dist. 945	2.80956
So is the departure 500	2.69897	So is co-sine cou. 50° 50′	9.80043
To sine cou. 50° 50′	9.88941	To diff. of lat. 407,3	2.60999

Lat.

Lat. left is	49°. 30′ N.	Lat. left	49°. 30′
Diff. lat. 407, or	6 . 47 S.	Lat. in	42 . 43
Latitude in	42 . 43 N.	Sum is	2)92 . 13
		Mid. lat.	46 . 6
		Co-mid. lat.	43 . 54

To find the Diff. of Long.			
As co-fi.m.lat.46°6′co.ar.	0.15902	Longitude left is	24 . 40 W.
Is to the departure 500	2.69897	Diff. of long. 721, or	12 . 1 E.
So is radius	10.00000		
		Long. in	12 . 39 W.
To diff. of long. 721,1	2.85799		

MERCATOR's SAILING.

PLANE SAILING, as has been before obſerved, ſuppoſes the earth and ſea to be in the form of a bowling-green, on which the meridians are parallel, and the degrees of latitude and longitude equal in all places; but the earth and ſea compoſe a round body, or globe, on which the degrees of latitude are equal in all places, and the degrees of longitude decreaſe from the equator in proportion to the ſine complements of the latitude.

Though the meridians all meet at the poles, and the parallels to the equator continually decreaſe, and that in proportion to the coſines of their latitudes; yet in old ſea-charts the meridians were drawn parallel to each other, and, conſequently, the parallels of latitude made equal to the equator, and ſo a degree of longitude on any parallel, as large as a degree on the equator: alſo, in theſe charts, the degrees of latitude were ſtill repreſented (as they are in themſelves) equal to each other, and to thoſe of the equator; by theſe means the degrees of longitude being increaſed beyond their juſt proportion, and the more ſo the nearer they approached the poles, the degrees of latitude at the ſame time remaining the ſame; it is evident places muſt be very erroneouſly marked down upon thoſe charts, with reſpect to their latitude and longitude, and, conſequently, their bearings from one another muſt be very falſe.

To remedy this inconvenience, ſo as ſtill to keep the meridians parallel, it is plain we muſt lengthen the degrees of latitude in the ſame proportion as thoſe of longitude are, that ſo the proportion in eaſting or weſting may be the ſame with that of northing or ſouthing; and, conſequently, the bearing of places from

from each other to be the fame upon the chart as upon the globe itfelf.

The difficulty in conftructing a true fea-chart confifts in finding a proper manner of applying the furface of a globe to a plane; which Mr. WRIGHT, an Englifhman, by an ingenious conception, happily accomplifhed.

He conceived the furface of this globe to fwell like a bladder while it is blowing up from the equator towards the poles, proportionally in latitude as it does in longitude, until every part of its furface meet that of a concave cylinder impreffed on it, whofe diameter was equal to the globe's diameter. The equator being thus confined, the parts towards the poles muft be extended, both in latitude and longitude, to fill up the cylinder, or figure, in the form of a rolling ftone, and imprefs on its concave furface the lines drawn on the furface of the globe. This cylinder being cut on one of the meridians, from north to fouth, and laid open, would reprefent a true fea-chart, the parts of which bear the fame proportion to one another as the correfponding parts of the globe do; and on which all the lines will be right lines; having every parallel of latitude on the globe increafed till it is equal to the equator; and fo the diftance of the meridians in thefe parallels will become equal to their diftance at the equators; confequently, the meridians on the chart are expreffed by parallel right lines.

Alfo the meridians being lengthened as the parallels are increafed, every degree of latitude is lengthened in the fame proportion as the degrees of longitude are increafed; therefore, the diftance of the parallels of latitude grow wider and wider as they approach the poles.

Mr. GERRARD MERCATOR, a Fleming, in 1556, publifhed a fimilar chart; but in what manner it was conftructed he did not fhow: neither were thofe degrees in their true proportion; whence called Mercator's Charts.

Mr. WRIGHT, in 1599, publifhed the Principles of the True Sea-Chart, and how to conftruct it on the following principles: viz.

That the diftance between any two meridians at the equator is in proportion to their diftance in any parallel of latitude, as the radius is to the co-fine of that latitude.

That any part of a parallel of latitude is to a like part of the meridian, as the radius is to the fecant of that parallel;

And, that the diftance of any parallel of latitude from the equator is equal to the fum of the fecants of all the arches between the equator and that parallel.

From thefe principles, Mr. Wright fet about forming a Table, by the continual additions of fecants, of all the parallels of latitude, beginning with one minute, which he made radius, and thereto adding the fecond parallel of 2 minutes, and to the fum of thefe two, the fecant of 3 minutes, &c. The Table thus formed, is that which is commonly called the Table of Meridional Parts, by means of which

which a true nautical chart may be conſtructed, called Mercator's Chart, and all the Caſes in WRIGHT's, commonly called Mercator's Sailing, conſtructed and calculated.

As this Table contains the meridional parts for every degree and minute of the quadrant, from the equator to the poles, it will be eaſy to find the meridional parts correſponding to any parallel of latitude, as for example:

Required the meridional parts correſponding to the latitude 33°. 45'?

Look in the top of the Table for 33°, marked 33d, and in the right or left-hand columns, marked (M), under the degrees 33, and oppoſite the minutes 45 ſtands 2153, the meridional parts belonging to 33°. 45'.

When the given latitudes are both north or both ſouth, the meridional difference of latitude is found by ſubtracting the meridional parts of the leſſer latitude from thoſe of the greater.

Required the meridional difference of latitude between the Lizard, in latitude 49°. 57'N. and the Iſland of St. Mary's, in latitude 37°. N.?

The Lizard's latitude	49° 57'	N.	meridional parts	3470
St. Mary's latitude	36. 58	N.	meridional parts	2390
			Meridional difference of latitude	1080

When the latitudes are one north, and the other ſouth, the meridional difference of latitude is found, by adding the meridional parts correſponding to both the latitudes together.

Required the meridional difference of latitude between Cape Verd, in latitude 14°. 46' N. and the Cape of Good Hope, in latitude 34° 29' S.?

Cape Verd's latitude	14°. 46'	N.	meridional parts	896
Cape of Good Hope's	34 . 29	S.	meridional parts	2207
			Meridional difference of latitude	3103

The ſeveral caſes in Mercator's Sailing are worked by geometry, trigonometry, Gunter's Scale, and the Tables of difference of latitude and departure, exactly in the ſame manner as thoſe in Plane Sailing, by only conſidering the meridional difference of latitude, as if it were the proper difference of latitude, and the difference of longitude as the departure: for it is no more than enlarging the proper difference of latitude, ſo as to be equal to the meridional difference of latitude; then will the difference of longitude bear the ſame proportion to the departure, that the meridional difference of latitude does to the proper difference of latitude; for, in the following figure (which is the firſt caſe in Mercator's Sailing):

Let M T repreſent the meridional and M L the proper difference of latitude, T H the difference of longitude, L O the departure, M O the diſtance, and the angle T M H, or L M O, the courſe; then will ML be in proportion to LO, as MT is to TH; and the contrary.

Wherefore,

Wherefore, as the proper difference of latitude is to the departure, so is the meridional difference of latitude to the difference of longitude; and

As the meridional difference of latitude is to the difference of longitude, so is the proper difference of latitude to the departure.

Since by lengthening or shortening the sides of a triangle does not alter the angles, the departure may be reduced into difference of longitude, and the difference of longitude into departure.

In all the cases (save the first) in Mercator's Sailing, the course, distance, difference of latitude and departure, are found in the same manner as those in Plane Sailing; and then the difference of longitude may be found by either of the following proportions, viz.

(See the Figure in the next page.)

By making the enlarged Distance M H radius, it will be,		By making meridional Difference of Lat. MT radius, it will be
As the co-sine of the course,	OR	As radius
Is to the merid. diff. of latitude		Is to the merid. diff. of latitude
So is the sine of the course		So is the tangent of the course
To the difference of longitude;		To the difference of longitude.

But in the first Case, it will be

As the merid. diff. of lat. MT	AND	As radius
Is to radius		Is to the proper diff. of lat. ML
So is the diff. of longitude TH		So is the secant of the course
To the tangent of the course;		To the distance MO.

Or, when the course is found, you may say, As the co-sine of course is to the proper difference of latitude, so is radius to the distance.

CASE I.

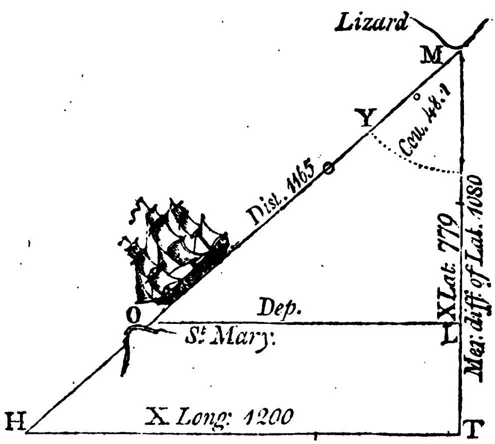
The Latitudes and Longitudes of two Places given, to find the direct Course and Distance between them.

Required the bearing and distance between the Lizard, in latitude 49° 57′, longitude 5° 12′ W. and the Island of St. Mary, one of the Western Islands, in latitude 37° N. and long. 25° 6′W.?

Lizard's lat.	49°. 57′ N.	meridional parts 3470	long. 5°. 12′ W.
St. Mary's	36 . 58 N.	meridional parts 2390	long. 25 . 12 W.
Diff. of lat.	12. 57=779	Diff. 1080	Diff. 20. 00=1200

Draw the mer. MT=1080, the meridional difference of lat. and MI=779, the proper diff. of lat.; perp. to MT, draw TH and LO, make TH 1200 miles, the diff. of long. join H and M; then will the angle TMH be the cou. S .48.01 W. and O M the dist. 1165 miles.

By PROJECTION.



By CALCULATION.

To find the Courſe, it will be,		To find the Diſtance, it will be,	
As m. diff. of l. 1080 co. ar.	6.96658	As co-ſi. cou. 48, 1 co. ar.	0.17463
Is to rad. 90°	10.00000	Is to p. diff. lat. 779	2.89154
So is the diff. of long. 1200	3.07918	So is rad.	0.00000
To tang of cou. 48° 01′	10.04576	To the Diſt. 1165	3.06617

By GUNTER.

1ſt. ' Extend from the merid. diff. of lat. 1080, to diff. of long. 1200; that extent will reach from rad. or 45°, to the cou. 48° 1′ on the line of tangents.'

2d. ' Extend from rad. or 90°, to the comp. of the cou. 41° 59′ on the line of ſines, that extent will reach from 779 to 1165 on the line of numbers.'

By INSPECTION.

1ſt. Look for the meridional diff. of lat. and diff. of long. until they are found ſtanding together in their reſpective columns (as if they were lat. and dep); and the cou. will be found among the degrees or points.

In the lat. column belonging to this cou. find the proper diff. of lat. oppoſite to which ſtands the diſt. in its column.

2. Now

2. Now $\frac{1}{10}$ of the meridional diff. of lat. and the $\frac{1}{10}$ diff. of the longitude are 108,0 and 120,0 the neareſt numbers in the Tables are 107,7 and 119,6 ſtanding together over 48°.

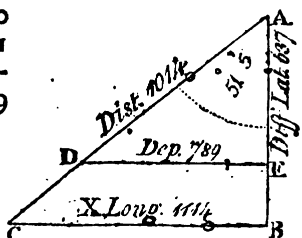
In the latitude column I look for $\frac{1}{10}$, the proper diff. of lat. which is 77,9, the neareſt is 77,6, againſt this ſtands 117 in the diſt. column, which multiplied by 10 gives 1170 nearly, the ſame as that found by calculation.

CASE II.

Both Latitude and the Departure from the Meridian given, to find the Courſe, Diſtance, and Difference of Longitude.

A ſhip in lat. 49° 57′ N. and long. 5°. 14′ W. ſails S. weſtward, until her departure from the meridian be 789 miles, and then by obſervation is in the lat. 39° 20′ N. required her courſe ſteered, diſtance run, and longitude in?

Lat. left	49°. 57′	Merid. parts	3470
Lat. in	39 . 20	Merid. parts	2571
Diff. of lat.	10. 37 = 637 miles	Diff.	899



By PROJECTION.

With the proper diff of lat. and dep. project the ſame as in Caſe VI. in Plane Sailing; extend the mer. AE to B, and make AB equal to the meridional diff. of lat. and draw a line parallel to the dep. DE; produce the diſt. AD to cut this parallel; and CB will be the diff. of long. Hence the angle BAC will be the cou. S. 50° 5′ W. DA the diſt. 1014, and BC the diff. of long. 1114 miles.

To find the ſame by CALCULATION.

As p. diff. lat. co. ar.	7.01586
Is to rad. 90°	10.00000
So is the dep. 789	2.89708
To tang. cou. 51° 5′ =	10.09294
As rad. 90°	10.00000
Is to mer. diff. lat. 899	2.95376
So is tang. cou. 51,5	10.09292
To diff. of long. 1114	3.04668

As ſine cou. 51° 5′ co. ar.	0.10899
Is to dep. 789	2.89708
So is rad. 90°.0′	0.00000
So the diſt. 1014	3.00607
Longitude left	5°. 14′ W.
Diff. of long. 1114 =	18 . 34 W.
Longitude in	23 . 48 W.

Her courſe is S. 51° 5′ W. and diſtance 1014 miles.

Note. The diff. of long. may be found by ſaying, As prop. diff. of lat. : dep. : : merid. diff. of lat. : diff. of long.

By GUNTER.

1ſt. 'The extent from diff. lat. 637, to dep. 789, on the line of numbers, will reach from rad. or 45°, to 51° 5', the cou. on the line of tangents.

2dly. 'The extent from rad. to com. cou. 38° 55', on the line of ſines, will reach from diff. lat. 637, to 1014, the diſt. on the line of numbers.

3dly. 'The extent from co-cou. 38° 55', to ſine cou. 51° 5' on the line of ſines, will reach from mer. diff. lat. 899, to 1114, the diff. of long. on the line of numbers.'

By INSPECTION.

The diff. of lat. and dep. being found together in their reſpective columns will give the cou. among the degrees or points, and the diſt. in its column; in the lat. column belonging to the cou. look for the meridional diff. of lat. and againſt it will ſtand the diff. of long. in the dep. column.

Now 1-ſixth of diff. of lat. and of dep. are 106,1 and 131,5, the neareſt numbers to theſe are 106,4 and 131,3, ſtanding together over 51° the cou. and againſt diſt. 169; this, multiplied by 6, gives 1014 the diſt.

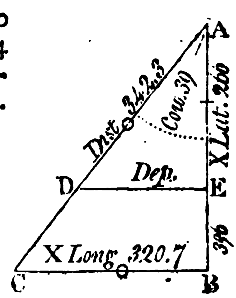
Again, over 51° look for 1-tenth of mer. diff. of lat. 89,9 in the lat. column, the neareſt is 90.0, and againſt which ſtand 111,1 in the dep. column; this, multiplied by 10, gives 1111 for the diff. of long.

CASE III.

Both Latitudes and Courſes given, to find the Diſtance and Difference of Longitude.

A ſhip from the Lizard makes her courſe S. 39° W. and then, by obſervation, is in lat. 45° 31' N.; required her diſt. run, and long. in?

Lat. of the Lizard	49° 57' N.	Mer. parts 3470
Lat. by obſer.	45 31 N.	Mer. parts 3074
Diff.	4 26=226 m.	diff. 396 M.



By CONSTRUCTION.

Draw a mer. AB, the upper end A will repreſent the ſhip's place in her firſt lat.

Take the proper diff. of lat. 266 in your compaſſes, and with one foot in A, the ſhip's place, lay the other upon the meridian; from

from A to E; take the mer. diff. of lat. 396 in your compasses, and with one foot in A, the ship's place, as before, lay the other upon the mer. at B; and upon these two points raise the perp. DE and CB; a line drawn from the ship's place, making an angle with the mer. equal to 39°, the ship's cou. will cut the two perps at D and C; the first will be the dep. which terminates the dist. AD 342, and the other will be the diff. of long. CB=321 miles.

From what has been said, it is plain, that any case in Mercator's Sailing may be projected as a right-angled triangle, by only considering the diff. of long. or dep. as the base; the meridional, or proper diff. of lat. as the perp.; the hypothenuse cut by the dep. as dist.; and the angle which that makes with the perp. the cou.; for in all cases in Mercator's Sailing, the meridional diff. of lat. bears the same proportion to the diff. of long. that the proper diff. of lat. does to the dep.

These instructions being well understood, will be sufficient to inform the Learner how to construct any of the following cases:

By CALCULATION.

To find the Distance.		To find the Diff. of Longitude.	
As co-si. cou. 39° co. ar.	0,10950	As the co-si. cou. 39° co. ar.	0.10950
Is to the diff. of lat. 266	2.42488	Is to mer. diff. of lat. 396	2.59770
So is radius	10.00000	So is sine cou. 39°	9.79887
To the dist. 342,3	2.53438	To dif. lon. 320,7=5°21'W.	2.50607

Lizard's longitude left	—	5°. 12' W.
Longitude in	—	10 . 33 W.

By GUNTER.

1st. 'The extent from co-sine cou. 51°, to rad. on the line of sines, will reach from the proper diff. of lat. 266, to the dist. 342,3 on the line of numbers.

2dly. 'The extent from co-sine cou. 51°, to sine cou. 39° on the line of sines, will reach from the mer. diff. of lat. 396, to the diff. of long. 321, on the line of numbers.'

By INSPECTION.

Under the cou. 39°, and against half the diff. of lat. 133, stands 171 in the dist. column, which being doubled is 342, the dist.; under the same degrees, and in the lat. column, look for half the mer. diff. of lat. 198, against that, in the dep. column, stands 160,5, doubled is 321, the diff. of long. nearly, as before.

CASE IV.

One Latitude, Course, and Distance given, to find the Difference of Latitude, and Difference of Longitude.

A ship in latitude 42° 30' N. and longitude 18° 31' W. sails S. W. by S.

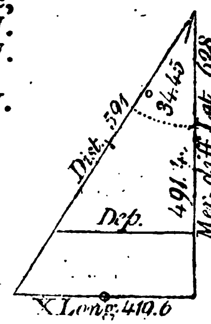
W. by S. 591 miles; I demand the latitude and longitude the ſhip is in?

To find the Difference of Latitude it will be,

As rad. 90°	10.00000	Lat. left 42°30′N.	M.pts.	2822
Is to the diſtance 591	2.77159	Diff.lat.491 8 11		2194
So is co-ſine cou. 3 pts.	9.91985	———		——
———		Lat. in 34 19N.	M.diff.oflat.	628
To the diff. of lat. 491,4	12.69144			
	———			

To find the Difference of Longitude it will be,

As co-ſi.co.3pts.co.ar.	0.08015	Lon. left 18°31′W.
Is to m.diff.of lat. 628	2.79796	Di.lo.420=7,00W.
So is S. cou. 3 pts.	9.74474	———
	———	Long. in 25 31W.
To diff. of lon. 419,6	2.62285	
	———	



By GUNTER.

1ſt. 'The extent from rad. or 5 points, the com. of the cou. on the line marked SR, will reach from the diſt. 591, to the diff. of lat. 491,4 on the line of numbers.

2dly. 'The extent from co-cou. 5 points, to the cou. 3 points, on the line marked SR, will reach from the mer. diff. of lat. 628 to the diff. of long. 419,6 on the line of numbers.'

By INSPECTION.

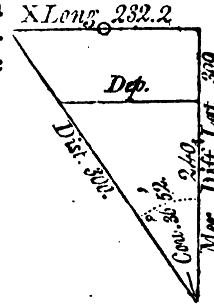
Under the cou. 3 points, and oppoſite a tenth of the diſt. 59,1 in the lat column ſtands 49,1, which, multiplied by 10, is 491, the diff. of lat.; then find ¼ of the mer. diff. of lat. 157, in the lat. column, againſt which ſtands 105 in the dep. column, which, multiplied by 4, gives 420, the diff. of long.

CASE V.

Both Latitudes and Diſtance given, to find the Courſe and Difference of Longitude.

If a ſhip runs 300 miles N. weſterly from a port in lat. 37° N. and long. 10° 25′ W. until ſhe be in lat. 41° N.; required the courſe ſteered and long. in?

Lat. left	37 N.	Mer. parts	2393
Lat. in	41 N.	Mer. parts	2702
	———		———
Diff. lat	4=240	M diff. lat.	309 M.



By

By CALCULATION.

To find the Courſe.		To find the Diff. of Long.	
As the diſt. 300 co. ar.	7.52288	As co-ſi. cou. 36° 52′ co. ar.	0.09639
Is to rad. 90°	10.00000	Is to mer. diff. of lat. 309	2.48996
So is pro. diff. of lat. 240	2.38021	So is ſine courſe 36° 52′	9.77812
To the co-ſine cou. 36° 52′	9.90309	To the diff. of long. 231,7	2.36497

Longitude left	—	18° 25′ W.
Diff. of long. 232, or		3 52 W.
Longitude in	—	14 17 W.

By GUNTER.

1ſt. 'The extent from the diſt. 300, to the proper diff. of lat. 240, on the line of numbers, will reach from rad. or 90°, to 53° 8′, the comp. of the cou. on the line of ſines.

2dly. 'The extent from co-cou. 53° 8′, to cou. 36° 52′, on the line of ſines, will reach from the mer. diff. of lat. 309, to the diff. of long. 231,7, on the line of numbers.'

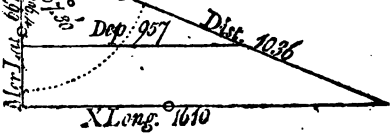
By INSPECTION.

With the diſt. and diff. of lat. find the cou. then in the lat. column belonging to this cou. find the mer. diff. of lat.; againſt which, in the dep. column, will ſtand the diff. of long.

Thus, half the diſt. 150, and half the diff. of lat. 120, will be found ſtanding together in their columns, nearly under 37°, the cou.; and, in the lat. column, find half the mer. diff. of lat. 154,5, the neareſt to it is 154,1; againſt which, in the dep. column, ſtands 116,1, which doubled is 232,2 the diff. of long. nearly as before.

CASE VI.

One Latitude, Courſe, and Departure given, to find the Diſtance, Difference of Latitude, and Difference of Longitude.



A ſhip ſails E. S. E. from a certain port in latitude 50° 10′ S. and longitude 10° 16′ E. until her departure from the meridian be 957 miles; I demand the diſtance ſailed, and the latitude and longitude ſhe is in?

To find the Diſtance it will be,

As ſine cou. 6 pts. co. ar.	0.03438
Is to the dep. 957	2.98091
So is radius	10.00000
To the diſtance 1036	3.01529

To find the Diff. of Lat. it will be,

As ſine cou. 6 pts co. ar.	0.03438
Is to the departure 957	2.98091
So is co-ſine cou. 6 pts.	9.58284
To diff. lat. 396=6° 36′	2.59813

To find the Diff. of Long.

As co-ſine cou. 6 pts. co. ar.	0.41716
Is to mer. diff. of lat. 667	2.82413
So is ſine courſe 6 pts.	9.96562
To diff. of long. 1610	3.20691

Lat. left, 50° 10′ S. mer. pts.	3490
Lat. in 56 46 S. mer. pts.	4157
Mer. difference lat.	667
Longitude left	10° 15′ E.
Diff. of long. 1610 =	26 50 E.
Longitude in	37 6 E.

By GUNTER.

1ſt. ‘ The extent from 6 points to rad. on the line marked SR, will reach from the dep. 957, to the diſt. 1036, on the line of numbers.

2dly. ‘ The extent from 6 points to 2 points, on the line marked SR, will reach from the dep. 957, to the diff. of lat. 396, on the line of numbers.

3dly. ‘ The extent from 2 points to 6 points on the line marked SR, will reach from the mer. diff. of lat. 667, to the diff. of long. 1610, on the line of numbers.’

By INSPECTION.

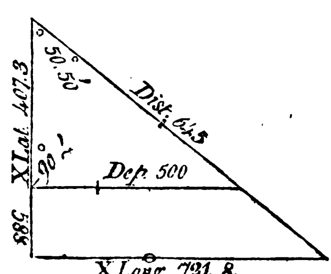
Over the cou. of 6 points, and againſt a fifth of the dep. 191,4 ſtands 79,2 and 207, which, multiplied by 5, gives 396, the diff. of lat. and 1035 for the diſt.

Then, in the lat. column, find a tenth of the mer. diff. of lat. 66,7, the neareſt to that is 66,6; againſt which, in the dep. column, ſtands 160,8, which, multiplied by 10, is 1608, the diff. of long.

CASE VII.

One Latitude, Diſtance ſailed, and Departure from the Meridian, given, to find the Courſe, Difference of Latitude, and Difference of Longitude.

A ſhip in latitude 49° 30′ N. and longitude 14° 40′ W. ſails S. eaſtward 645 miles, until her departure from the meridian be 500 miles. Required the courſe ſteered, and the latitude and longitude ſhe is in?



To

To find the Course it will be,		To find the Diff. of Lat. it will be,	
As the distance 645 co. ar.	7.19044	As sine cou. 50° 50′ co. ar.	0.11052
Is to rad.	10.00000	Is to the departure 500	2.69897
So is the departure 500	2.69897	So is co sine cou. 50° 50′	9.80043
To sine cou. 50° 50′	9.88941	To diff. lat. 407,3 = 6° 47′	2.60992

To find Diff. of Long. it will be,			
As co-si. cou. 50° 50′ co. ar.	0.19957	Lat. left 49° 30′ N. M. pts.	3428
Is to m. diff. of lat. 588	2.76938	Lat. in 42 4 N. M. pts.	2840
So is sine course 50° 50′	9.88948	Mer. diff. lat.	588
To diff. lon. 721,8 = 12° 2′	2.85843	As pro. diff. of lat. 407,3 co. ar.	7.39008
Long. left	14 40	Is to departure 500	2.69897
Long. in	2 38 W.	So is m. diff. of lat. 588	2.76938
		To diff. of long. 271,8	2.85843

Hence the ship's cou. is S. 50° 50′ E. or S. E. ½ east nearly, and she is in the lat. of 42° 43′ N. and long. 2° 38′ W.

By GUNTER.

1st. 'The extent from the dist. 645, to the dep. 500 on the line of numbers, will reach from radius to 50° 50′ on the line of sines.

2dly. 'That extent from 50° 50′ to 39° 10′, on the line of sines, will reach from the dep. 500, to the diff. of lat. 407, on the line of numbers.

3dly. 'The extent from 39° 10′ to 50° 50′, on the line of sines, will reach from the mer. diff. of lat. 588, to the diff. of long. 722, on the line of numbers.'

By INSPECTION.

Now a 5th of the dist. and dep. are 129 and 100, and are found together over 51°; and in the lat. column stands 81,2, which, multiplied by 5, is 406, the diff. of lat.

Then, in the lat. column, seek ¼ of the meridional diff. of lat. 147, the nearest is 146,6; against which, in the dep. column, stands 181,1, which, multiplied by 4, is 724,4 the diff. of long.

Having, in the preceding parts, shewn how to work the most useful problems in Middle Latitude and Mercator's Sailing; I shall now work the three following cases both by Middle Latitude and Mercator's Sailing, in a manner I generally teach persons who are of age, and youth of good abilities; especially if they are limited to a short time.

The Difference of Latitude and Departure given, to find the Course, Distance, and Difference of Longitude, by Middle Latitude and Mercator's Sailing.

A ſhip from latitude of 37° N, and longitude 48° 20′ W. ſails between the north and eaſt, until ſhe be in latitude 51° 15′ N. and finds that ſhe has made 564 miles of departure; what was her direct courſe, diſtance run, and longitude in?

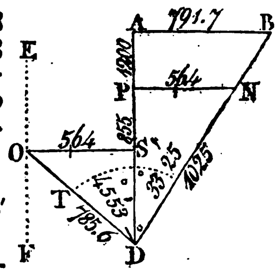
Lat. left 37°. 0′ N. Mer. parts 2393
Lat. in 51 . 15 N. Mer. parts 3593

14 . 15 = 855 miles diff. 1200

Sum lat. ½)88 . 15

Mid. lat 44 . 7 90° . 0′
44 . 7

Comp. mid. lat, 45 . 53



Draw the mer. DP, make it equal to 855 the diff. of lat.; on P erect the perp. PN, and make it = 564 the dep.; join D and N, then will the angle PDN be the cou. N. 33° 25′ E. and DN the diſt. 1024 miles.

At the diſt. of the dep. 564, draw EF parallel to DP; with the chord of 60° deſcribe the arch TS, and upon it ſet off the comp. of the mid. lat. 45° 53′ from S to T, through T draw DO, and cut EF in O, then will OD be the diff. of long. 785,6 miles, by Mid. Lat. Sailing.

Again, produce DP to A, and make DA = 1200 the mer. diff. of lat.; draw AB parallel to PN, and produce DN until it cuts AB in B; then will AB be 791,7 miles, the diff. of long. by Mercator's Sailing.

By CALCULATION.

As diff. of lat. 855 co. ar.	7.06803	As ſine cou. 33° 25′ co. ar.	0.25907
Is to radius	10.00000	Is to the dep. 564	2.75128
So is the departure 564	2.75128	So is radius	0.00000
To tang. of cou. 33° 25′	9.81931	To the diſt. 1024	3.01035

To find the Difference of Longitude.

By Middle Latitude Sailing.		By Mercator's Sailing.	
As co-ſi. m lat. 44° 7′ co. ar.	0.14392	As co-ſi. cou. 33° 25′ co. ar.	0.07848
Is to the departure 564	2.75128	Is to mer. diff. lat. 1200	3.07918
So is rad. 90°	10.00000	So is the ſine cou. 33° 25′	9.74093
To d. of lon. 785,6 = 13° 6′	2.89520	To diff. lon. 791,7 = 13° 12′	2.89859
Lon. left	48 20 W.	Long. left	48 20 W.
Long. in	35 14 W. by M. Lt. Sail.	Long. in	35 8 W. by Mer. Sail.

Her direct courſe is N. 33° 25′ E. or N. E. by N. nearly, and diſtance 1024 miles.

By GUNTER.

1st. 'Extend from 855 to 564 on the line of numbers, that extent will reach from rad. or 45°, to 33° 25' the cou. on the line of tangents.

2dly. 'Extend from rad. or 90°, to the cou. 33° 25' on the line of sines, that extent will reach from the dep. 564, to the dist. 1024, on the line of numbers.

3dly. 'Extend from rad. or 90°, to the comp. of mid. lat. 45° 53', on the line of sines, that extent will reach from the dep. 564, to 786 miles, the diff. of long. by Mid. Lat. Sailing.

4thly. 'Extend from the sine of the cou. 33° 25' to the co-sine of the cou. 56° 35', on the line of sines, that extent will reach from the meridional diff. of lat. 1200 to 792 miles, the diff. of long. by Mercator.

Or, 'The extent from the diff. of lat. 855, to the dep. 564, will reach from the meridional diff. of lat. 1200, to 792, on the line of numbers.'

By INSPECTION.

With the diff. of lat. and dep. find the cou. and dist. as in Case VI. in Plane Sailing. Take the comp. of mid. lat. as a cou. and the dep. in its column, the corresponding dist. will be the diff. of long. by Mid. Lat. Sailing. And,

Having found the cou. instead of the proper diff. of lat. find the meridional diff. of lat. in the lat. column belonging to the cou.; the corresponding dep. will be the diff. of long. by Mercator's Sailing.

Now, taking 1-tenth of the diff. of lat. 1-tenth of the dep. viz. 85,5 and 56,4, the nearest numbers standing together in the Tables to these are 85,5, and 55,5 under 33° against dist. 102, and 85,4, and 57,6 under 34° against dist. 103; now 33° added to 34° is 67°, half is 33° 30' the cou.; and 102 added to 103 gives 205, half is 102,5, which, multiplied by 10, gives 1025 the dist.

To find the Difference of Longitude.

Over the comp. of mid. lat. 46°, find ¼ of the dep. viz. 141 in its column, and against it stands 196 in the dist. column, this, multiplied by 4, gives 784 miles, the diff. of long. by Mid. Lat. Sailing.

Again, the cou. being 33° 25', or nearly 33° ½, look for 1-tenth of meridional diff. of lat. = 120 in the lat. columns, under 33° and 34°, the nearest numbers to these are 110,9 and 120,2, the dep. corresponding are 77,9, and 81,1, their sum is 159, half is 79,5, which, multiplied by 10, gives 795, the diff. of long. by Mercator's Sailing, nearly as before.

From what has been said, it is easy to perceive that all the Cases (save the first) in Mid. Lat. and Mercator's Sailing, are projected and worked in the same manner as in Plane Sailing; and

 to

to obtain the diff. of long. by Mid. Lat. Sailing; the comp. of the mid. lat. is taken as a cou. in Plane Sailing, and with this cou. and the dep. the dist. is found, which will be the diff. of long. by Mid. Lat. Sailing. And having the cou. take the meridional diff. of lat. as if it was the proper diff. of lat. the correſponding dep. will be the diff. of long. by Mercator's Sailing.

The Courſe and Diſtance given, to find the Difference of Latitude, and Difference of Longitude.

A ſhip from the latitude 51° 15′ N. and longitude 9° 50′ W. ſails S. W. by S. until ſhe has run 1022 miles, what latitude and longitude is ſhe in?

To find the Departure.		To find the Latitude.	
As rad. 90°	0.00000	As rad. 90°	0.00000
Is to the diſtance 1022	3.00945	Is to the diſtance 1022	3.00945
So is ſine courſe 3 pts.	9.74474	So is coſine courſe 3 pts.	9.91985
To the departure 567,8	2.75419	To the diff. of lat. 849,8	2.92930

Now 849,8 or 850 divided by 60, gives 14° 10′ S. and being ſubtracted from the latitude left, leaves 37° 5′ the latitude in: hence the middle latitude is found to be 44° 10′, and meridional difference of latitude 1194. Whence,

To find the Difference of Longitude by Mid. Lat. Sailing.		To find the Difference of Longitude by Mercator's Sailing.	
As co ſi.m.lat.44° 10′co.ar.	0.14429	As co-ſi. cou. 3 pts. co. ar.	0.08015
Is to the departure 567,8	2.75420	Is to mer. diff. of. lat. 1194	3.07700
So is radius 90°	10.00000	So is ſine courſe 3 pts.	9.74474
To the diff. of lon. 791,6	2.89849	To diff. of long. 797,8	2.90189
Longitude left	9° 50′ W.	Longitude left	9° 50′ W.
Diff. of long. 792	=13 12 W.	Diff. of long. 798	=13 18 W.
Long. in by mid. lat.	=23 2 W.	Long. in, by Mercator	23 8 W.

The Courſe and Difference of Latitude given, to find the Diſtance and Difference of Longitude.

A ſhip in 37° N. lat. and long. 22° 56′ W. ſails N. 22° 20′ E. for ſeveral days, and then by obſervation is found to be in the lat. 51° 15′ N.; required the diſtance run, and long. in?

Lat.	51° 15′	Mer. parts	3593
Lat.	37 0	Mer. parts	2393
Diff.	14 15 × 60 = 855 miles		1200 = merid. diff. of lat.
Sum ½)	88 15 = 44,7 mid. lat.		

As

As co-ſi.cou.22° 20′ co. ar.	0.033386	As co-ſi.cou.22° 20′ co.ar.	0.033386
Is to diff. of lat. 855	2.93197	Is to diff. of lat. 855	2.93197
So is ſine courſe 22° 20′	9.57978	So is radius 90°	0.00000
To the departure 351,3	2.54561	To the diſtance 924,3	2.96583

To find the Difference of Longitude.

By Mid. Lat. Sailing.		By Mercator's Sailing.	
As co-ſi.m.lat.44° 7′ co.ar.	0,14392	As co-ſi.cou.22° 20′ co. ar.	0.03386
Is to the departure 351	2.54531	Is to mer. diff. of lat. 1200	3.07918
So is radius 90°	10.00000	So is ſine cou. 22° 20′	9.57978
To diff. L. 489 = 8° 9′ E.	2.68923	To diff. lon. 493 = 8° 13′	2.69282
Lon. left 22 56 W.		Long. left 22 56	
Long. in 14 47 W. by m. lat.		Long. in 14 43 W. by M.	

Caſe the firſt in Middle Latitude and Mercator's Sailing, and theſe three caſes are all that can well happen at ſea; but as ſome young men are inattentive, and frequenly looking into the book to ſee if their calculation *is* the ſame as that ſet down,

The Teacher, perhaps, may find it neceſſary to let ſuch work the following queſtions by way of exerciſe:—

Queſt. 1ſt. Required the bearing and diſtance of Hang. Cliff in Shetland, in lat. 60° 7′ N. and long. 50′ W. and the North Cape of Lapland, in lat. 71° 10′ N. long. 26° 1′ E?

Anſ. { N. 44° 47′ E. diſt. 934,1 miles, by Mercator's Sailing.
N. 45° 4′ E. diſt. 941,2 miles, by Mid. Lat. Sailing.

Queſt. 2d. A ſhip in lat. 37° N. and long. 48° 20′ W. ſails between the N. and E. until ſhe is in the lat. of 51° 18′ N. and finds ſhe has made 564 miles of dep.; required her direct cou. diſt. run, and long. in?

Anſ. { N. 33° 38′ E. diſt. 1018 miles, long. in 34° 42′ W. by Middle Latitude Sailing.
N. 33° 38′ E. diſt. 1018 miles, long. in 35° 9′ by Mercator's Sailing.

Queſt. 3d. A ſhip from the lat. of 50° 30′ N. ſails S. S. W. 150 leagues; what lat. is ſhe in, and how much has ſhe differed her long.?

Anſ. { Lat. in 43° 34′ N. diff. of long. 252,9 miles, by Mercator's Sailing.
Lat. in 43° 34′ N. diff. of long. 252,3 miles, by Middle Latitude Sailing.

Queſt. 4th. A ſhip from lat. 20° 40′ N. ſails N. E. by E. until ſhe be in the lat. of 27° 16′ N.; required her diſt. run, and diff. of long.?

Anſ. { Diſt. run 712,8 miles, diff. of long. 648,1 miles, by Mercator.
Diſt. run 712,8 miles, diff. of long. 648,6 miles, by Mid. Lat.

Queſt.

Quest. 5th. Suppose a ship from the lat. of 45° 40′ N. sails between the S. and E. 600 miles, and then her dep. is computed to be 308 miles; required the cou. lat. and diff. of long.?

Ans. Course S. 30° 53′ E. lat. in 37° 5′ N. diff. of longitude 411,5 by Mercator.
Course S. 30° 53′ E. lat. in 37° 5′ N. diff. of longitude 412,0, by Mid. Lat.

Quest. 6th. A ship from the lat. 45° 30′ S. sails N. N. W. until her diff. of long. be 7° 40′; required the lat. she is in, and her dist. sailed?

NOTE. This must be worked by Mercator's Sailing, thus:

As the sine cou 22° 30′ is to the diff of long. 460, so is the co-sine cou. 22° 30′ to the mer diff. of lat. 1110. Now, from the mer. parts of lat. left 3073, take the mer. diff. of lat. 1110, the remainder 1963 is the mer. parts. of the lat. come to 31° 4′ S. Having the cou. and proper diff. of lat. the rest is found by Case II. in Plane Sailing.

Ans. The ship is in lat. 31° 4′ S. dist. 937,4 miles.

Quest. 7th. A ship in the lat. 51° 15′ N. and long. 22° W. sails between S. and W. until she has made 564 miles of dep. and 786 miles of diff. of long.; required her cou. dist. lat. and long. in?

Note. This must be worked by Mid. Lat. Sailing, as thus:—

As diff. of long. 786 : rad. : : the dep. 564 : co-sine of mid. lat. 44° 9′, + 44° 9′ = 88° 18′ the sum lat. and 88° 18′ − 51° 15′ = lat. in 37° 3′ N. Having the diff. of lat. and dep. the cou. is found to be S. 34° 7′ W. and the dist. 1006 miles.

It may now be supposed that the Learner is capable of working any single course, either by Mid. Lat. or Mercator's Sailing; we shall now proceed to Compound Courses, commonly called Traverse Sailing, which may be worked by Mid. Lat. and Mercator's Sailing, either by projection, calculation, Gunter's scale, or inspection.

How to solve compound courses, or a traverse, has already been shewn in Plane Sailing; but it is necessary also to shew, how proper allowances for the longitude should be introduced into such accounts, which is easily done by any of the following methods:—

1st. Complete the Traverse Table to each cou. and dist. as in Plane Sailing; and find the whole diff. of lat. dep. and lat. in.

2dly. With the whole diff. of lat. and dep. find the direct cou. and dist.

3dly. With the latitude left and latitude in, find the complement of the middle latitude; with which, and the departure, find the difference of longitude by Middle Latitude Sailing.

Or, with the course and meridional difference of latitude, find the difference of longitude by Mercator's Sailing.

These methods are generally used in working a day's work at sea; but those that want a greater degree of accuracy may work by the following methods, especially in high latitudes:

By

By the ſeveral differences of latitudes and departures, found in the Tables of Difference of Latitude and Departure, find the latitudes come to, middle latitudes, and complements of middle latitudes; with each complement of middle latitude and correſponding departure, find the difference of longitude to each courſe and diſtance, and ſet them down in two additional columns, marked difference of longitude eaſt and weſt, according to the departure uſed; add up the eaſt and weſt columns, and their difference will be the whole difference of longitude, by Middle Latitude Sailing.

But if you work by Mercator's Sailing, find the Meridional difference of latitude for each courſe and diſtance; with each courſe and meridional difference of latitude, find the difference of longitude; which ſet down as above directed, and the difference between the eaſt and weſt columns will be the difference of longitude by Mercator's Sailing. By this method the ſhip's place may be found at the end of each courſe and diſtance run, and pricked off on a Mercator's chart.

EXAMPLE I.

Suppoſe a ſhip from the Land's End, in latitude 50° 4′ N. and longitude 5° 41′ 31″,5 W. is bound to the Iſland of St. Mary, in latitude 37° N. and longitude 25° 6′ W. but by reaſon of contrary winds is obliged to ſteer the following courſes, viz. S. by W. 24 miles; W. S. W. 32, N. W. ½ W. 41, S. S. E ¼ E. 49. E. N. E. ¾ E. 19, W. 21, N. E. ½ E. 36, S. 41, S. S. W. 92, and N. 36 miles; and it be required the latitude and longitude ſhe is in, with the direct courſe and diſtance to her intended port.

With the ſeveral courſes and diſtances, find their differences of latitude and departure, and ſet them down as in the following

TRAVERSE TABLE.

COURSES.	DIST.	DIFF. OF LAT.		DEPARTURE.	
		N.	S.	E.	W.
S. by W.	24		23,5		4,7
W. S. W.	32		12,2		29,6
N. W. ½ W.	41	26,0			31,7
S. S. E. ¼ E.	49		44,3	21,0	
E. N. E. ¾ E	19	4,6		18,4	
Weſt	21				21,0
N. E. ½ E.	36	22,8		27,8	
South	41		41,0		
S. S. W.	92		85,0		35,2
North	36	36,0			
		89,4	206,0	67,2	122,2
			89,4		67,2
		Dif. lat. S.	116,6	Depar.	55,0

It

It is plain by the Traverſe Table, that the ſhip has made 116,6 miles of ſouthing, and 55 miles of weſting.

Now from latitude left	50 . 4′	Meridian parts	3481
Take diff. of lat. 117 =	1 . 57		
Latitude in	48 . 7 N.	Meridian parts	3302
Sum latitudes	2)98 . 11		
Middle latitude	49 . 5	Mer. diff. lat.	179

Whence, to find the Difference of Longitude it will be,

By Mid. Lat. Sailing.		By Mercator's Sailing.	
As co-ſine mid lat. 49° 5′	0.18378	As p. diff. of lat. 116,6	7.93330
Is to the dep. 55	1.74036	Is to the dep. 55	1.74036
So is rad. 90°	10.00000	So is m. diff. of lat. 179	2.25285
To diff. of long. 84=1° 24′	1.92414	To diff long. 84,4=1° 24′	1.96251
Long. left	5°.42′	Long left	5 42
Long. in	7 . 6 by m. lat.	Long. in	7 6 by mer.—W.

By INSPECTION.

Taking the comp. of mid. lat. 41° as a cou. and the dep. 55 in its col. the neareſt is 55,1 againſt which ſtands 84 in the diſt. col. the diff. of long. by Mid. Lat. Sailing. And,

With the proper diff. of lat. and dep.; the cou. found nearly 25° and diſt. 129 under the cou.; in the lat. col. look for the mer. diff. of lat.; 179, the neareſt is 180,4 againſt which ſtands 84,1, in the dep. col. which is the diff. of long. by Mercator's Sailing.

To find the direct Courſe and Diſtance to St. Mary's.

Lat of ſhip	48° 7′ N.	Mer. pts 3302	Lon. of ſhip	7° 6′W.	
Lat. St. Mary's	36 58 N.	Mer. pts. 2390	L. St. Mary's	25 12 W.	
Diff. lat.	11 9=669 ms.	Diff. 912	Diff. of long	18 . 6=1086	
Sum lat.	2)85 5				
Mid. lat.	42 32				

By Middle Latitude Sailing.

As the diff. of lat. 669	7.17457	As co. ſi. courſe 50 7′	0.19299
Is to diff. long. 1086	3.03583	Is to prop. diff. of lat. 669	2.82543
So is co. ſi mid. lat. 42° 32′	9.86740	So is rad. 90°	10.00000
To tang. cou. 50° . 7	10.07780	To the diſt. 1043	3.01842

By

By Mercator's Sailing.

As mer. diff. of lat. 912	7.04001	As rad. 90°	0.00000
Is to rad. 90°	10.00000	Is to p. diff. lat. 699	2.82543
So diff. of long. 1086	3.03583	So is fec. cou. 49° 59′	0.19178
To tang. cou. 49° 59′	10,07584	To the dift. 1041	3.01721

Hence the direct courfe from the fhip to St. Mary's is S. 50° 7′ W. and diftance 1043 miles, by Middle Latitude Sailing; and S. 49° 59′ W. and diftance 1041 miles by Mercator's Sailing. The fame may be found

By INSPECTION.

Take ¼ of the diff. of long. 1086, viz. 271,5 nearly, and look for that in the dift. column over the comp. middle lat. 47° nearly, and in the dep. column ftands 198,5¼ of the dep. Then look for ¼ of the diff. of lat. 167,2, and ¼ of dep. 198,5 until they are found ftanding together in their refpective columns, the neareft are found over 50°, viz. 199,2, 167,5; the dift. correfponding to thefe is 260, this multiplied by 4 gives 1040 miles. Hence the courfe is S. 50° W. dift. 1040 miles, by Mid. Lat. Sailing.

Again, taking $\frac{1}{10}$ of the meridional diff. of lat. and $\frac{1}{10}$ of the diff. of longitude, viz. 91,2, and 108,6, the neareft numbers to thefe are 108,8, 91,3 ftanding over 50° in the lat. column, belonging to the above degree; look for $\frac{1}{10}$ of the proper diff. of lat. viz. 66,9, the neareft is 66,8, the diftance is 104, which being multiplied by 10, gives 1040 miles.

Hence the cou. is S. 50° W. and dift. 1040 miles, by Mercator's Sailing, the fame as by calculation.

Here, to have gone to geometrical ftrictnefs, the diff. of long. fhould have been found to every cou. and dift. run, by Mid. Lat. or Mercator's Sailing, which would have given the fhip's true place at the end of each cou. and dift. but fhall leave the doing of that to the Reader; and as all traverfes are worked in the manner fhewn above, which is fufficiently exact for a fhip's run in 24 hours, I fhall therefore only add a few queftions for the Learner's exercife.

Suppofe a fhip from the lat. 68° 38′ N. and long. 8° 40′ E. is bound to the North Cape, in 71° 10′ N. and long. 26° 0′ E. fails as in the following Table; required the lat. and long. fhe is in, and her direct cou. and dift. to the Cape.

COURSES.	D.	N.	S.	E.	W.	LAT. IN		Diff. Long.	
								E.	W.
						68	38		
N. E. by N.	63	52,4		35,0		69	30	97,	
N. E.	38	26,9		26,9		69	57	78,0	
N. N. E.	56	51,7		21,4		70	49	64,2	
North.	30	30,0				71	19		
N. W. by N.	25	20,8			13,9	71	40		44,
N. N. W. ½ W.	36	31,7			17,0	72	12		55,0
N. by E.	40	39,2		7,8		72	51	25,9	
N. E. by E. ½ E.	72	33,9		63,5		73	25	219,1	
S. E.	50		35,4	35,4		72	50	121,0	
E. N. E.	65	24,9		60,1		73	15	207,7	
		311,5	35,4	250,3	30,9			812,9	99,
		35,4		30,9				99,	
Diff. of lat.		276,1	Dep.	219,4		Diff. lon.		713,9	E.

In working the above, the diff. of long. is found by the cou. and mer. diff. between each par. of lat.; or, it may be done by taking the comps. of each mid. lat. and the dep. for each course.

Now the lat. left was	68° 38′ N.	Lon.	8° 40′ E.
The d. of l. 276 ms. =	4 36 N.	Diff. lon. 714 m. =	11 54 E.
Lat. in	73 14 M. p. 6583.	Lon. in	20 34 E.
Lat. of N. Cape	71 10 M. p. 6177.	Lon. of Cape	26 0 E.

The diff. lat. 2°. 4′ Mer. diff. lat. 406. Diff. of long. 5°. 26′ = 326 miles,

With the mer. diff. of lat. 406, and diff. of long. 326, the cou. between the ship and the Cape is S 38°. 44′ E. dist. 159 miles by Mercator; and S. 38° 47′ E. dist. 159,1 by Mid. Lat. Sailing.

By INSPECTION.

With ⅓ of diff of lat. 276, and ⅓ of dep. 219, viz. 92 and 73, the cou. made good is 38° 30′ and dist. 354 miles.

And with $\frac{1}{10}$ of mer. diff. of lat. 849, and the cou. 38° 30′, the diff. of long. is 676, by Mercator's Sailing.

And with the comp. of mid. lat. 19,2, and the dep. 219, the diff. of long. is 675, nearly, by Mid. Lat. Sailing; diff. from that above 38 miles, by Mercator, and 39 miles by Mid Lat. Sailing.

But as ships never run such dist in 24 hours, the first method of finding the diff. of long. will be sufficiently exact for any day's run.

The bearing and distance to the North Cape may be either found

B. Pennye sculp.

found by Mid. Lat. or Mercator, by Inſpection; which will be nearly as above.

A ſhip from the Lizard, in lat. 49° 57′ N. and long. 5° 12′ W. is bound to Funchal in Madeira, in lat. 32° 38′ N. and long. 17° 5′ W. ſteers the following cou. S. S. W. 250 miles, W. 156, S. E. by S. 300, W. by N. 180, and S. 185 miles; required the lat. and long. ſhe is in, and her direct cou. and diſt. to the intended port?

By finding the diff. of long. for each cou. by calculation, the ſhip is in lat. 39° 27′ N. and long. 11° 15′ W. by Mercator's Sailing; but by working by the whole diff. of lat. and dep. the long. will be 11° 19′ W.

The cou. from the ſhip to Funchal is S. 34° 19′ W. diſt. 495,2 miles by Mercator's Sailing:

And S. 34°, 23′ W. diſt. 495,3 miles, by Mid. Lat. Sailing.

A ſhip from lat. 38° 14′ N. and long. 25° 56′ W. runs the following courſes and diſtances, viz. N. E. by N. ¾ E. 56 miles, N. N. W. 38, N. W. by W. 46, S. S. E. 30, S. by W. 20, and N. E. by N. 60 miles; required the direct cou. and diſt. made good, and the lat. and long. ſhe is in?

The cou. is N. 14° E. diſt. 108 miles, lat. in 39° 59′ N. long. in 25° 22′ W.

Suppoſe a ſhip in lat. 67° 30′ N. and long. 8° 46′ W. ſails the following courſes, N. E. 64 miles, N. N. E. 50, N. W. by N. 58, W. N. W. 72, W. 48, S. S. W. 38, S by E. 45, and E. S. E. 40 miles; what lat. and long. is ſhe in?

By working by the whole diff. of lat. and dep. the ſhip is in lat. 68° 44′ N. and long. 11° 4′ W. But

By finding the diff. of long. for each cou. and diſt. ſhe is in long. 11° 37′ W. by Mid. Lat. Sailing, and 11° 44′ W. by Mercator's Sailing.

Having gone through the neceſſary Problems in Mercator's Sailing, we ſhall now proceed to ſhew how the true chart, commonly called Mercator's Chart, may be conſtructed either for the whole, or any part of the Terraqueous Globe.

When a Chart is to commence from the Equator, or if the Equator is to run through it.

Having provided a ſcale of convenient length, draw a line to repreſent the Equator, and, croſſing that at right angles, another to repreſent the meridian of ſome known place, ſuch as London, Paris, the Lizard, or any other place whoſe longitude is known; the upper end of which will repreſent the north, and the lower the ſouth.

From the ſcale take 60 in your compaſſes, and with 1 foot upon the meridian, ſet off that diſtance on both ſides of it upon the equator, if the chart is to contain eaſt and weſt longitude; but, if it is only to contain weſt longitude, lay it off upon the left-hand ſide of the meridian; but if eaſterly, on the right-hand ſide, and that

will point out the degrees of longitude, which may be divided into halves, quarters, or minutes, if required.

Having ſet off as many degrees of longitude as you intend the chart ſhould contain, through the laſt draw a line (or lines) parallel to the meridian, which will be the bounds of the chart eaſt and weſt.

Having divided the equator as above, proceed to ſet off upon the two extreme meridians from the equator, the meridional parts (as found in the Table) belonging to each degree of latitude; that is, take from the ſcale in your compaſſes the miles anſwering to one degree in the Table, and, with one foot in the equator, ſet off that diſtance on each ſide of it upon the extreme meridians, if the chart is to contain north and ſouth latitude; but if only north or ſouth, upon one ſide of the equator.

Again, take the meridional parts anſwering to 2 degrees and 3 degrees, &c. in your compaſſes, and ſet them off upon the meridian, from the equator, as before.

In like manner proceed to ſet off as many degrees as you intend the chart ſhould contain; or, which will be the ſame thing, take the meridional difference of latitude between any 2 parallels, and ſet them off ſeverally from the leaſt latitude.

Lay a ruler on each of theſe diviſions, and draw lines parallel to the equator, and they will be parallels of latitude, each of which will be enlarged towards the poles, in proportion as the degrees of longitude are.

Parallel to the meridian, draw lines through the points, expreſſing the degrees of longitude, to cut the parallels of latitude, which bound the chart north and ſouth.

The parallels of latitude may alſo be divided into halves, quarters, or minutes, by taking the meridional parts for degrees and minutes, and ſetting them off as before.

Draw double lines on the borders of the chart, and mark out the degrees of latitude and longitude; and, in ſome convenient place, draw the compaſs. In like manner may a chart be made that ſhall contain any number of degrees and minutes required. When the chart is not to commence from the equator, but is only to ſerve from a certain diſtance on the meridian, between two parallels on the ſame ſide of the equator, then the meridians are to be drawn as before, and for the parallels of latitude you are to proceed thus:—

From the meridional parts anſwering to each point of latitude in your chart, ſubtract the meridional parts anſwering to the leaſt latitude, and ſet off the difference ſeverally from the parallels of the leaſt latitude upon the two extreme meridians, and the lines joining theſe points of the meridian will repreſent the ſeveral parallels upon the chart.

Let it be required to draw a chart that ſhall ſerve from the latitude of 14 degrees north, to 52 degrees north, and that ſhall contain 25 degrees of longitude weſt of the meridian of Greenwich. See the Chart, page 110.

Draw

Draw a line to represent the meridian of Greenwich, from which set off towards the left hand 25 degrees of west longitude, as before directed; through the two last points draw lines parallel to the meridian of London, and these will be the extreme meridians, or east and west bounds of your chart.

Having drawn the two meridians on the lower edge of the paper, draw a line perpendicular to the meridians, to represent the parallel of 14 degrees north; then, from the meridional parts answering to 15 degrees 910, subtract the meridional parts answering to 14 degrees 849, and take the difference, 61, in your compasses, and set it off from the parallel on both the meridians from you, and that will represent the parallel of 15 degrees.

Again, take the meridional parts of 15 degrees 910, from the meridional parts of 16 degrees 973, and set off the difference 63, upon the meridians from the point representing the parallel of 15 degrees, and that will represent the parallel of 16 degrees. In like manner proceed to set off the parallels upon the meridians.

Or, if the meridional parts of 14 degrees be subtracted from the meridional parts of every succeeding parallel, and the difference be set off from the parallel of 14 degrees upon the meridians, these points will represent the several enlarged parallels of latitude, the same as before; and, if it be required that the meridians should be divided into degrees and minutes, the meridional parts for such must be taken from the Table, and set off as above.

Having set off as many parallels as you intend the chart should contain, through each point draw parallels; or if you think drawing lines through every degree will crowd your chart too much, you may divide the borders only into single degrees, &c. and draw lines through every 5 degrees of latitude and longitude, as in the chart.

Take from the Table of Latitude and Longitude of Places, the latitude and longitude of each particular place contained within the bounds of the chart, and lay a ruler over its latitude, and another crossing that over its longitude; the points where these cross will represent the proposed place upon the chart. In like manner may any place be readily marked. Hence the particular points of a sea-coast may be laid down as above, and lines properly drawn from point to point will form the outlines of the sea-coasts, islands, &c. to which may be annexed, the depths of water, setting of currents, and whatever else may be thought convenient for the chart to contain.

This map or chart is not to be considered as a just or similar representation of the earth's surface, for in it the figures of islands and countries are distorted near the poles. For

Suppose an island in the latitude 60° N. or S. where the breadth of a degree of longitude is just half as large as a degree upon the equator. Now, as the degrees of latitude are enlarged in proportion as the degrees of longitude are expanded towards the poles, it is plain, that every point of that island or country, being laid down

in its proper latitude and longitude, will be reprefented twice as large as it really is.

Hence it follows, that as the degrees of latitude are every where increafed, like thofe of longitude, it is plain the bearing between places will be the fame on this chart as on the globe; and the proportions between the latitude and longitude and nautical diftances, will be the fame upon this chart as upon the globe.

And fince the meridians in this projection are right lines, it follows, that the rhumbs, which form equal angles with the meridians, will be ftraight lines, which render this projection of the earth's furface much more eafy and proper for the mariner's ufe than any other.

Gunter's Scales have drawn upon them two lines, one marked N M, fignifying the Nautical Meridian; and the other, directly under it, marked E P, fignifying Equal Parts, or degrees of longitude upon a Mercator's Chart.

Thofe are equal parts, or degrees of longitude, to which the degrees of the nautical meridian are fitted, by increafing them, in their true proportion; hence the limits or bounds of a Mercator's Chart by thefe lines are eafily made, by transferring the divifions correfponding to the degrees to be ufed from the fcale to the paper the chart is to be drawn upon: but as the degrees drawn by thefe lines are too fmall for the feaman's ufe, it is much better to ufe a fcale of equal parts as before, and, confequently, the degrees may be made of any propofed length.

By the Latitude and Longitude in, to prick off the Ship on the Chart.

Rule. Lay the ruler acrofs the chart in the latitude your fhip is in, then look upon the equator, or line marked with the degrees of longitude, for the longitude your fhip is in by your reckoning, and fetting one foot of your compaffes in that longitude, take the neareft diftance to fome north and fouth line, and from where that line croffes the edge of the ruler that lies in the given latitude, lay off that fame diftance along the edge in the ruler to the right hand, if the longitude you are in was to the right hand of the north and fouth line; or to the left hand, if it was to the left hand; where this falls will be the place of the fhip; but this will only do when the longitude marked on the chart, and your reckoning of longitude in, are both counted from the fame meridian. Therefore, for a general rule, take the following, viz.

By the Latitude in and Longitude made, to prick off the Ship's Place.

Rule. Set one foot of your compaffes in the place you take your departure from, and take the neareft diftance to fome north or fouth line, and from where that falls upon the equator, or the line marked with the degrees of longitude, fet off that diftance the fame way the place lies from it; that is, to the right hand, if the place

place lies to the right hand of the north and ſouth line, or to the left hand if it lies to the weſt; and make a mark with a black lead pencil; this mark will ſerve to prick off by, till you come to take a new departure; and then rub it out, and make a new one as before.

Then lay a ruler acroſs the chart in the latitude you are in, and taking ſo many degrees in your compaſſes from the line of longitude, as your longitude made comes to, ſet them off from your black-lead mark along the edge of the ruler to the eaſtward; if the longitude made be eaſt, or to the weſtward if it be weſt; where this falls will be the longitude the ſhip is in by the chart; from which take the neareſt diſtance to ſome north and ſouth line, and from where that line, &c. as in the firſt caſe.

The ſhip's place on the chart being found, as before taught, it remains in the next to ſhew how to find the bearing and diſtance of any place from the ſhip; and firſt,

To find how any Place bears from the Ship.

RULE. Lay a ruler from the place of the ſhip to the place you would know the bearing of; then ſet one foot of your compaſſes in the centre of ſome compaſs near the ruler, and take the neareſt diſtance to the edge of the ruler: then run one foot of your compaſſes along by the edge of the ruler, and obſerve what point of the compaſs the other comes neareſt to, which will be the bearing required.

CASE I.

To find the Diſtance of any Place from the Ship.

If the place be in the ſame longitude that the ſhip is in; that is, if it bears due north or ſouth, then the difference of latitude between them, turned into miles or leagues, will be the diſtance.

CASE II.

If the place be in the ſame latitude the ſhip is in; that is, if it bears due eaſt or due weſt, then take half the diſtance between the ſhip and the place in your compaſſes; and, ſetting one foot on the line marked with the degrees of latitude, in the latitude the ſhip is in, ſee what latitudes the other foot will reach to, both above and below it; the difference between theſe two latitudes will be the diſtance required.

CASE III.

When they are neither in the ſame Latitude nor in the ſame Longitude with the Ship.

RULE. Take the difference of latitude between both places in your compaſſes from the equator, or graduated parallel; and laying a ruler over both places, put one foot upon the ſhip's place, and ſlide

ſlide your compaſſes along the edge of the ruler (holding both points parallel to the meridian) until the other cuts the parallel of latitude paſſing through the place (or any E. and W. line cut by the ruler) then ſtay the compaſſes. Take the diſtance between where the point reſted by the edge of the ruler and the place (or where the ruler croſſed the aforeſaid eaſt and weſt line) in your compaſſes, and apply it to the equator, or graduated parallel, and that will give their diſtance in degrees, which may be turned into miles or leagues; and in the ſame manner as you find the bearing and diſtance between the ſhip and any place, you may alſo find the bearing and diſtance of one place from another; or if the diſtance between the ſhip and place be taken in your compaſſes, and applied to the ſide of the chart, or graduated meridian, nearly in the parallels of the ſhip and place, it will give the diſtance in degrees as before; and for this purpoſe there are generally marked on the ſides of charts ſcales of leagues, by which the diſtance between the places may be readily found.

Or the diſtance between two places upon a Mercator's Chart may be eaſily found, thus:

Take half the diſtance between any two places, and with one foot of the compaſſes in the middle parallel, extend both ways upon the graduated meridian; count the number of degrees between both points, which will be your diſtance, either in leagues or miles, according as the ſcale is divided; or take the diſtance in your compaſſes, and ſet one foot as much above the one place as the other point is below the other place, on the meridian: the number of degrees between the points of the compaſſes will be the diſtance.

EXAMPLE.

Required the Bearing and Diſtance between Cape St. Vincent *and* Teneriffe?

Lay a ruler over both places, and take their difference of latitude 8° 30′, from the equator or graduated parallel, in your compaſſes; and ſlide one foot along the edge of the ruler from Teneriffe, holding the other point in the direction of the line CB, until the other point juſt touches the eaſt and weſt line, (AB) paſſing through St. Vincent, as at B, from C, where the foot of the compaſſes reſted, by the edge of the ruler, and St. Vincent being meaſured, and applied to the graduated parallel, gives 10 two-third degrees, or 640 miles the diſtance.

Again, take the neareſt diſtance between the centre of the compaſs in your compaſſes, and ſliding them along the edge of the ruler, as before directed, you will find the courſe to be S. W. by S. ¼ W. nearly.

Hence the direct courſe between Cape St. Vincent and Teneriffe is S. W. by S. ¼ W. diſtance 640 miles, or 213 one-third leagues; and the ſame with other places.

OF

OF WINDS.

THE earth is endued with a wonderful principle of gravitation, whereby all its parts are ſtrictly united together; and all bodies that are looſe upon it cloſely adhere to its ſurface, tending directly towards its centre. Hence it is, that ſhips are able to ſail with the ſame facility every where (void of impediments) upon the ſurface of the ſea, quite round the terraqueous globe; and that (as to ſenſe) there is no ſuch thing as an upper or lower part of the earth; for let the inhabitant be in what part ſoever, he will there gravitate towards the earth's centre, and imagine himſelf to be on the higheſt point of its ſurface; from whence he will obſerve the heavens like a large vault over his head, and his antipodes he will imagine to be directly under him, as they will alſo theirs, for the like reaſons. According to this law of gravity, if the earth was at reſt, (and not acted upon by any other power) and its parts looſe, or its ſurface all over covered with a deep fluid, it would naturally form itſelf into a true ſphere, or globe.

Notwithſtanding this power of attraction, yet the ſun, whoſe rays upon the earth cauſe vapours or fumes to be continually riſing from it, which muſt partake of the quality of thoſe parts from whence they are evaporated; a collection of which form what we call our air or atmoſphere, ſurrounding the earth, and extending ſome miles above its ſurface, and is liable to be put in motion by various cauſes. Hence, air is a fine elaſtic fluid, and is found capable of being compreſſed or condenſed by cold, and expanded or rarefied by heat.

Conſequently, an alteration of heat or cold happening in any part of the atmoſphere, the air in that part will be either condenſed or rarefied, and the neighbouring parts will thereby be put into motion, through the endeavour which the air by its elaſticity or ſpringineſs always makes to reſtore itſelf to its former ſtate, or come to an equilibrium.

Wind is a ſtream or current of air, which generally blows from one part of the horizon to its oppoſite.

The following obſervations have been made on it, particularly by Dr. Halley, which are not unworthy the Seaman's notice.

Between 30 degrees north latitude, and 30 ſouth latitude, there is a conſtant eaſt wind throughout the year, blowing on the Atlantic and Pacific oceans, and this is called the Trade Winds.

For as the ſun, in moving from eaſt to weſt, heats the air more immediately under him, and thereby expands it; the air to the eaſtward is conſtantly ruſhing towards the weſt to reſtore the equilibrium or natural ſtate of the atmoſphere, which occaſions a perpetual eaſt wind in thoſe limits.

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The trade winds, near these northern limits, blow between the north and east; and, near the southern limits, they blow between the south and east.

For as the air is expanded by the heat of the sun near the equator, therefore the air from the northward and southward will both tend toward the equator to restore the equilibrium: now these motions from the north and south, joined with the foregoing easterly motions, will produce the motions observed near those limits, between the north and east, and between the south and west.

These winds, if the whole surface of the globe were sea, would undoubtedly blow quite round it, as they are found to do in the Atlantic and Ethiopic oceans; but seeing such great continents interpose and break the continuity of the ocean, regard must be had to the nature of soils, and the positions of high mountains, which are the principal causes of the variety of winds differing from the former general one.

In some parts of the Indian ocean there are periodical winds, which are called Monsoons: that is, such as blow half the year one way, and the other half the contrary way.

For air that is cool and dense will force the warm and rarefied air into a continual stream upwards, where it must spread itself to preserve the equilibrium; so that the upper course or current of the air shall be contrary to the under current; for the upper air must move from those parts where the greatest heat is, and so by a kind of circulation the N. E. trade wind below will be attended with a S. W. above; and a S. E. below, with a N. W. above:—And this is confirmed by the experience of seamen, who, as soon as they get out of the trade winds, immediately find a wind blowing from the opposite quarter.

In the Atlantic ocean, near the coasts of Africa, at about 100 leagues from shore, between the latitudes of 28° and 10° north, seamen constantly meet with a fresh gale of wind blowing from the N. E.

Those bound to the Caribbee Islands, across the Atlantic, find, as they approach the American side, that the N. E. wind becomes easterly, or seldom blows more than a point from the east, either to the northward or southward.

The trade winds on the American side are extended to 30°, 31°, or even to 32° of north lat.; which is about 4° farther than what they extend to on the African side; also, to the southward of the equator, the trade winds extend 3 or 4 degrees farther towards the coast of Brasil on the American side, than they do near the Cape of Good Hope on the African side.

Between the latitudes of four degrees north, and four south, the wind always blows between the south and east: On the African side the winds are nearest the south, and on the American side nearest the east. In these seas Dr. Halley observed, that when the wind was eastward, the weather was gloomy, dark, and rainy, with hard gales of wind; but when the wind veered to the southward,

ward, the weather generally became ſerene, with gentle breezes, next to a calm.

Theſe winds are ſomewhat changed by the ſeaſon of the year; for when the ſun is far northward, the Braſil S. E. wind gets to the ſouth, and the N. E. wind to the eaſt; and when the ſun is far ſouth, the S. E. wind gets to the eaſt, and the N. E wind on this ſide of the equator veers more to the north.

Along the coaſt of Guinea, from Sierra Leon to the iſland of St. Thomas, under the equator, which is above 500 leagues, the ſoutherly and S. W. winds blow perpetually; for the S. E. trade wind having paſſed the equator, and approaching the Guinea coaſt, within 80 or 100 leagues, inclines towards the ſhore, and becomes S. S. E. then ſouth, and by degrees, as it comes near the land, it veers about to S. S. W. and within the land it is S. W. and ſometimes W. S. W. This track is troubled with frequent calms, and violent ſudden guſts of wind, called Tornadoes, blowing from all points of the horizon.

The reaſon of the wind ſetting in weſt on the coaſt of Guinea is, in all probability, owing to the nature of the coaſt, which being greatly heated by the ſun, rarefies the air exceedingly, and conſequently the cool air, from off the ſea, will keep ruſhing in to reſtore the equilibrium.

Between the 4th and 10th degrees of north latitude, and between the longitude of Cape Verd, and the eaſtmoſt of the Cape Verd Iſlands, there is a tract of ſea which ſeems to be condemned to perpetual calms, attended with terrible thunder and lightning, and ſuch frequent rains, that this part of the ſea is called The Rains. Ships in ſailing theſe 6 degrees have been ſometimes detained whole months, as is reported.

The cauſe of this ſeems to be, that the weſterly winds ſetting in on this coaſt, and meeting the general eaſterly winds in this track, balance each other, and ſo cauſe the calms; and the vapours carried thither by each wind meeting and condenſing, occaſion the almoſt conſtant rains.

The laſt three obſervations ſhew the reaſon of the two following, which mariners experience in ſailing from Europe to India, and in the Guinea trade. The difficulty which ſhips in going to the ſouthward, eſpecially in the months of July and Auguſt, find in paſſing between the coaſts of Guinea and Brazil, notwithſtanding the width of the ſea is not more than 500 leagues. This happened becauſe the S. E. winds at that time of the year commonly extend ſome degrees beyond the ordinary limits of 4° N. latitude; and beſides, coming ſo much ſoutherly, as to be ſometimes ſouth, ſometimes a point or two to the weſt: it then only remains to ply to windward. And if, on the one ſide, they ſteer W. S. W. they get a wind more and more eaſterly; but then there is danger of falling in with the Brazilian coaſt, or ſhoals; and if they ſteer E. S. E. they fall into the neighbourhood of the coaſt of Guinea, from whence they cannot depart without running eaſterly as far as

the island of St. Thomas; and this is the constant practice of all the Guinea ships.

All ships departing from Guinea for Europe, their direct course is northward; but on this course they cannot go, because the coast bending nearly east and west, the land is to the northward; therefore as the winds on this coast are generally between the S. and W. S. W. they are obliged to steer S. S. E. or S. and with these courses they run off the shore; but in so doing they always find the wind more and more contrary, so that when near the shore they can lie south; at a great distance they can make no better than S. E. and afterwards E. S. E. with which courses they generally fetch the island of St. Thomas, and Cape Lopez, where finding the winds to the eastward of the south, they sail westerly with it, till coming to the latitude of four degrees south, where they find the S. E. wind blowing perpetually.

On account of these general winds, all those that use the West-India trade, even those bound to Virginia, reckon it their best course to get as soon as they can to the southward, that so they may be certain of a fair and fresh gale to run before it to the westward; and for the same reason those homeward bound from America endeavour to gain the latitude of 30°, where they first find the wind begin to be variable, though the most ordinary winds in the North Atlantic ocean come between the south and west.

Between the southern lats. of 10° and 30° in the Indian ocean, the general trade-wind, about S. E. by S. is found to blow all the year round in the same manner as in the like lats. in the Ethiopic ocean, and during the six months, from May to December, these winds reach to within 2° of the equator; but during the other six months, from November to June, a N. W. wind blows in the track lying between the 3d and 10th degrees of southern lat. in the meridian of the north end of Madagascar; and between the 2d and 12th degrees of south lat. near the long. of Sumatra and Java.

In the track between Sumatra and the African coast, and from 3° of S. lat. quite northward to the Asiatic coast, including the Arabian sea and the Gulph of Bengal, the monsoons blow from September to April on the N. E. and from March to October on the S. W. In the former half year, the wind is more steady and gentle, and the weather clearer than in the latter six months: and the wind is more strong and steady in the Arabian sea than in the Gulph of Bengal.

Between the island of Madagascar and the coast of Africa, and hence northward as far as the equator, there is a track wherein, from April to October, there is a constant fresh S. S. W. wind, which, to the northward, changes into the W. S. W. wind blowing, at that time, in the Arabian sea.

To the eastward of Sumatra and Malacca, on the north of the equator, and along the coasts of Cambodia and China, quite through the Philippines, as far as Japan, the monsoons blow northerly and southerly; the northern setting in about October or November, and

and the ſouthern about May. Theſe winds are not quite ſo certain as thoſe in the Arabian ſea.

Between Sumatra and Java to the weſt, and New Guinea to the eaſt, the ſame northerly and ſoutherly winds are obſerved; but the firſt half year the monſoons incline to the N. W. and the latter to the S. E. Theſe winds begin a month or ſix weeks after thoſe in the Chineſe ſeas ſet in, and are quite as variable.

Theſe contrary winds do not ſhift from one point to its oppoſite all at once: in ſome places the time of the change is attended with calms; in others by variable winds; and it often happens on the ſhores of Coromandel and China, towards the end of the monſoon, that there are moſt violent ſtorms, greatly reſembling the hurricanes in the Weſt Indies, wherein the wind is ſo vaſtly ſtrong, that hardly any thing can reſiſt its force.

All navigation in the Indian ocean muſt neceſſarily be regulated by thoſe winds; for if mariners ſhould delay their voyages till the contrary monſoon begins, they muſt either ſail back, or go into harbour, and wait for the changing of the trade winds.

Vapours riſing from the ſea, and by the wind carried over low lands to the ridges of mountains, and compelled to mount up with the ſtream of the air to the tops, where the water preſently precipitates, gliding down by the chinks and cliffs of the ſtones, and part of the water entering into the caverns of hills, and gathering into baſons, which being once filled begin to run over, and form ſubterraneous paſſages through the earth, breaking out in ſprings by the ſides of hills; ſeveral of thoſe meeting together form a rivulet; ſeveral of theſe rivulets meeting together make a river. This, together with what is incorporated into vegetables, renders it impoſſible for all the water evaporated from the ſea to return to it again.

Hence the evaporations ariſing from the Mediterranean are ſuch, that notwithſtanding there are nine capital rivers, which empty themſelves into it, beſide ſmaller ones, there is a conſtant current running through the Straits of Gibraltar from the Atlantic ocean, to make up the deficiency. R. Mean, M. D. and F. R. S. obſerves, 1. That ſome diſeaſes are probably the effects of the influence of the heavenly bodies. 2. That the moſt windy ſeaſons of the year are about the vernal and autumnal equinoxes. 3. All the changes we have enumerated in the atmoſphere do fall out at the ſame times when thoſe happen in the ocean; and, as both the waters of the ſea and the air of our earth or fluids are ſubject in a great meaſure to the ſame laws of motion, ſo that natural effects of the ſame kind are owing to the ſame cauſes. 4. The alteration made by the ſun and moon in the atmoſphere muſt thereby have influence on the animal body. 5. The elaſticity of the air is of great moment, and it is reciprocally as the preſſure, ſo that the incumbent weight being diminiſhed by the attraction, the air underneath will be much expanded; theſe, and ſuch like cauſes, will make the tides in the air to be much greater than thoſe of the ocean; and there is no doubt to be made, but that the ſame infinitely wiſe Being, who contrived

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the flux and reflux of the seas, to secure that vast collection of waters from stagnation and corruption, has ordered this ebb and flood of the air of our atmosphere with the like good design; that is, to preserve it sweet, and a brisk temper of this fluid so necessary to life, by a continual circulation. 6. Two contrary winds blowing towards the same place, may accumulate the air there, so as to increase the height and the weight of the incumbent cylinder; in like manner the direction of two winds may be such, as meeting at certain angles, may keep the gravity of the air in a middle state; but if the wind blows different ways from the same place (which may be occasioned by thunder and lightning) the height and weight of the air may be much decreased. 7. The changes in our atmosphere at high water, new and full moon, the equinoxes, &c. must occasion alterations in all animal bodies, for all living creatures require air of a determined gravity to perform respiration easily; for it is by its weight that this fluid insinuates itself into the cavity of the breast and lungs: by a slow circulation the secretion of the spirits is diminished; and by the want of the force of elasticity and gravity, the juices begin to ferment, change the union of their parts, break their canals, and diseases follow.

Besides the above causes, the atmosphere may be put in motion by the elastic vapours forced from the bowels of the earth by subterraneous heats, and condensed by whatever causes in the atmosphere. A mixture of effluvia in different qualities in the air may, by rarefaction, fermentation, &c. produce winds and other effects like those resulting from the combination of some chemical liquors; and that such things happen, we are assured from the nature of thunder, lightning, and meteors. From the eruption of volcanoes and earthquakes in distant places, wind may be propagated to remoter countries. The divided or united forces of the other planets, and of the comets, may variously disturb the influence of the sun and moon, &c. We know that there happen violent tempests in the upper region of the air, when we below enjoy a calm, and how many ridges of mountains there are on our globe which interrupt and check the propagation of the winds, so that it is no wonder that the phœnomena we have ascribed to the action of the sun and moon, are not always constant and uniform, and that every effect does not hereupon follow; which, were there no other powers in nature able to alter the influence of, this might, in a very regular and uniform manner, be expected from it.

That the rarefied air ascends is sufficiently demonstrated by the aerostatic globe, or air balloon, lately invented: this is a globe made of silk, or other light stuff, made air tight with gum; which, being filled with inflammable or rarefied air, will, when let loose, ascend, until it comes to that part of the atmosphere that is nearly as light as the air within it, where it will continue some time.

OF

OF TIDES.

A TIDE is that motion of the water in the feas and rivers, by which they regularly rife and fall: the general caufe of which was difcovered by Sir ISAAC NEWTON, and is deduced from the following confiderations:——Daily experience fhews, that all bodies, when thrown upwards from the earth, fall down to its furface in perpendicular lines; and as lines perpendicular to the furface of any fphere tend towards its centre, the lines, along which all heavy bodies fall, muft be directed towards the earth's centre.

As bodies appear to fall by their weight or gravity, the law, by which they defcend, is called the law of gravitation: and as a magnet or loadftone will draw fmall portions of iron or fteel, and as a piece of glafs, amber, or fealing-wax, when warmed by rubbing, will draw fmall bits of paper, and other light fubftances, the law, by which fuch bodies fly to thofe which draw them, is called the law of attraction. Hence it is not improper to fay, that bodies, when falling by their gravity towards the earth, are *attracted* by the earth; and therefore the words gravitation and attraction may, refpecting the earth, be ufed indifferently, as by them is only meant that power, or law, by which all bodies tend towards its centre.

Sir ISAAC difcovered, by a great number of obfervations, that this law of gravitation or attraction was univerfally diffufed throughout the folar fyftem; and that the regular motions, obferved among the heavenly bodies, were governed by it; fo that the earth and moon attract each other, and both of them are attracted by the fun. He alfo difcovered, that the force of attraction, mutually exerted by thefe bodies, was leffened as the diftance increafed, in proportion to the fquares of thofe diftances; that is, the power of attraction, at double the diftance, was four times lefs; at triple the diftance nine times lefs; at quadruple the diftance, fixteen times lefs, and fo on.

As the earth is attracted by the fun and moon, it follows, that all the parts of the earth will not gravitate towards its centre in the fame manner as they would do, if thofe parts were not affected by fuch attractions. And it is evident, that were the earth entirely free from fuch actions of the fun and moon, the ocean, being on all fides equally inclined towards its centre by the force of gravity, would continue in a perfect ftagnant ftate, without ever ebbing or flowing. But, as the cafe is otherwife, the water in the ocean muft needs rife higher in thofe places where the fun and moon diminifh its gravity, or where they have the greateft attraction.

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As the force of gravity muſt be diminiſhed moſt in thoſe parts of the earth to which the moon is neareſt, or in the zenith, becauſe her attraction will there be moſt powerful; therefore the waters, in ſuch places, will riſe higher, and it will in them be full ſea or high-water. The parts of the earth directly under the moon, and alſo thoſe in the nadir, viz. ſuch places as are diametrically oppoſite to thoſe where the moon is in the zenith, will have high-water at the ſame time. For either half of the earth would gravitate equally towards the other half, were they ſuperfluous free from all attraction. But by the action of the moon, the gravitation of one half of the earth towards its centre is diminiſhed, and that of the other increaſed. In the half-earth next the moon, the parts directly under her being moſt attracted, and conſequently their gravitation towards the earth's centre moſt diminiſhed, the waters in theſe parts muſt be higher than in any other part of this half-earth. And in the half-earth, fartheſt from the moon, the parts in the nadir being leſs attracted by her than thoſe which are nearer, gravitate leſs towards the earth's centre, and conſequently, the waters in thoſe parts muſt be higher than they are in any other part of this half-earth.

Thoſe parts of the earth where the moon appears in the horizon, or is 90 degrees diſtant from the zenith and nadir, will have their loweſt waters. For as the waters in the zenith and nadir riſe at the ſame time, the adjacent waters will preſs towards thoſe places to reſtore the equilibrium; and, to ſupply the places of theſe, others will move the ſame way, and ſo on to 90° diſtant from the ſaid zenith and nadir: conſequently the waters, in thoſe places where the moon appears in the horizon, will have moſt liberty to deſcend towards the centre; and therefore they will, in ſuch places, be the loweſt. Hence it plainly follows, that the ocean, if it covered the ſurface of the earth, would put on a ſpheroidal, or egg-like figure, in which the longeſt diameter would paſs through the place where the moon is vertical; and the ſhorteſt where ſhe is in the horizon. And as the moon apparently ſhifts her poſition from eaſt to weſt in going round the earth every day, the long diameter of the ſpheroid, following that motion, would occaſion the two floods and ebbs in about every 25 hours, which is about the length of a lunar day, or the time ſpent between the moon's leaving the meridian of any place, and her coming to it again. Hence, the greater the moon's meridian altitude is at any place, the greater will thoſe tides be which happen when ſhe is above the horizon; and the greater her meridian depreſſion is, the greater will thoſe tides be, which happen when ſhe is below the horizon. The ſummer day, and the winter night, tides, have a tendency to be the higheſt; becauſe the ſun's ſummer elevation, and his winter depreſſion are greateſt: this is more eſpecially to be obſerved when the moon has north declination in ſummer and ſouth declination in winter.

The time of high-water is not preciſely at the time of the moon's coming

coming to the meridian, but about an hour after. For the moon continues to act with some force after she has passed the meridian, and by that means adds to the libratory, or waving motion, which she put the water into whilst she was on the meridian; in the same manner as a small force applied upwards to a ball, already raised to some height, will raise it still higher. The tides are greater than ordinary twice every month; that is, about the times of new and full moon: they are called spring tides. At these times the sun and moon concur to draw in the same right line; and therefore the sea must, under such joint influences, be more elevated than at other times. During the time of their conjunction, or whilst they are on the same side of the earth, they both conspire to raise the water in the zenith, and consequently in the nadir: and when the sun and moon are in opposition, that is, when the earth is between them, whilst one makes high-water in the zenith and nadir, the other does the same in the nadir and zenith. The tides are less than ordinary twice every month; that is, about the times of the first and last quarters of the moon; these are called neap-tides: because in the quarters of the moon, the sun raises the water where the moon depresses it, and depresses where the moon raises the water; so that the tides are then caused only by the difference of their actions. Hence it is necessary to observe, that the spring-tides happen not exactly at the new and full moon, but generally three days after, when the attracting powers of the sun and moon have conspired for a considerable time. In like manner the neap-tides happen about three days after the quarters, when the moon's attraction has been lessened by that of the sun for several days together.

When the moon is in her *perigæum*, or nearest approach to the earth, the tides rise higher than they do under the same circumstance at other times; for, according to the laws of gravitation, the moon must attract most when she is nearest the earth. The spring-tides are greater about the time of the equinoxes, that is, about the latter end of March and September, than at other times of the year; and the neap-tides are then less; because the longer diameter of the spheroid, or the two opposite floods, being then in the earth's equator, will describe a great circle of the earth; by the diurnal rotation of which, those floods will move swifter, describing a great circle in the same time they used to describe a less one, parallel to the equator; and consequently the waters being thrown more forcibly against the shores, must cause them to rise higher.

The following observations have been made on the rise of the tides: namely, the morning tides generally differ in their rise from the evening tides. The new and full moon spring tides rise to different heights. In winter the morning tides are highest. In summer the evening tides are highest. Thus it appears, that, after a period of about six months, the order of the highest tides are inverted; that is, the rise of the morning and evening tides will

change places, the winter morning high-tides becoming the ſame as the ſummer evening high-tides. Some of theſe effects ariſe from the different diſtances of the moon from the earth after a period of ſix months, when ſhe is in the ſame ſituation with reſpect to the ſun; for, if ſhe be in perigee at the time of the new moon, ſhe will, in about ſix months after, be in perigee about the time of full moon. Theſe particulars being well known, a pilot may chuſe that time which will prove moſt convenient for conducting a ſhip out of any port, where there is not a ſufficient depth of water on common ſpring tides.

Small inland ſeas, ſuch as the Mediterranean and Baltic, are little ſubject to tides; becauſe the action of the ſun and moon is always nearly equal to the extremities of ſuch ſeas. The tides, in very high latitudes alſo, are very inconſiderable; for the ſun and moon acting towards the equator, and always raiſing the water towards the middle of the torrid zone, the neighbourhood of the poles muſt conſequently be deprived of the waters, and the ſea within the frigid zones muſt be low in compariſon to the other parts.

All the things hitherto explained would be exactly obtained, were the whole ſurface of the earth covered with ſea. But ſince there are a multitude of iſlands, beſides continents, lying in the way of the tide which interrupt its courſe; therefore there ariſe, in many places near the ſhores, a great variety of other appearances, beſides the foregoing ones, which require particular ſolutions, in which the ſituations of the ſhores, ſtraits, ſhoals, winds, and other things, muſt neceſſarily be conſidered. For inſtance; as the ſea has no viſible paſſage between Europe and Africa, let them be ſuppoſed one continent, extending from 79° north, to 34° ſouth: the middle of thoſe two would be in latitude 19° north, near Cape Blanco, on the weſt coaſt of Africa. But it is impoſſible the flood tide ſhould ſet to the weſtward, upon the weſtern coaſt of Africa (for the general tide, following the courſe of the moon, muſt ſet from eaſt to weſt), becauſe the continent, for above 60°, both northward and ſouthward, bounds that ſea on the eaſt; and therefore, if any regular tide, proceeding from the motion of the ſea, from eaſt to weſt, ſhould reach this place, it muſt be either from the North of Europe ſouthward, or from the South of Africa northward.

This opinion is further corroborated, or rather fully confirmed, by common experience, which ſhews that the flood-tide ſets to the ſouthward along the weſt coaſt of Norway from the North Cape to the Naze, or entrance of the Baltic Sea, and ſo proceeds to the ſouthward along the eaſt coaſt of Great Britain, and in its paſſage ſupplies all thoſe ports which lie in its way, one after another. The coaſt of Scotland has the tide firſt, becauſe it comes from the northward to the ſouthward. On the full and change days, it is high-water at Aberdeen at 12h. 45m. but at Tinmouth-bar not till 3h. Rolling thence to the ſouthward, it makes high-water at the

the Spurn a little after 5h. at Yarmouth Roads a little after 8h. at Harwich at 10h. 30m. at the Nore 12h. and at London 2h. 30m. all in the fame day. And although this may feem to contradict the hypothefis of the natural motion of the tides being from eaft to weft, yet as no tide can come weft from the main continent of Norway or Holland, it is evident that the tide we have been tracing, by its feveral ftages from Scotland to London, is fupplied by that tide, the original motion of which is from eaft to weft. As water always inclines to the level, it will in its paffage fall to any other point of the compafs, to fill up vacancies where it finds them; and yet not contradict, but rather confirm, the hypothefis.

While the flood tide is thus gliding to the fouthward along the eaft coaft of England, it alfo fets to the fouthward along the weft coafts of Scotland and Ireland; one branch of it falls back north-eaft into St. George's Channel; and another runs between Ufhant and the Lizard, into the Britifh Channel. Some may object that this courfe of the flood-tide, eaft up the Channel, is quite contrary to the hypothefis of the general motions of the tides being from eaft to weft; and confequently of its being high-water where the moon is vertical, or any where elfe on the meridian. But it may be anfwered, that this particular direction of the tides does not contradict the general direction of the whole. A river with a weftern courfe may fupply canals which wind north, fouth, or even eaft, and yet the river keep its natural courfe; and if the river ebbs and flows, the canals fupplied by it would alfo do the fame, although they did not keep exact time with the river; becaufe it would be flood, and the water advanced to fome height in the river, before it reached the fartheft part of the canals; and the more remote the extremity of the canals are, the longer time it would require; it may alfo be added, that if it were high-water in the river juft when the moon was on the meridian, fhe would be far paft it before it could be high-water in the remoteft part of thofe canals; and the flood would fet according to the courfe of the canals that received it, and could not fet weft upon a canal of a different pofition. As St. George's Channel, the Britifh Channel, &c. are no more in proportion to the vaft ocean, than fuch canals would be to a large navigable river; it will evidently follow that the flood-tide may, among thofe obftructions and confinements, fet upon any other point of the compafs, as well as weft; and may make high-water at any other time, as well as when the moon is upon the meridian, without any wife contradicting the general theory of the tides.

Among pilots it is cuftomary to reckon the time of high-water by the point of the compafs the moon bears on at that time, allowing three quarters of an hour for each point. Thus, in places where it is high-water at noon, on the full and change days, the tide is faid to flow north and fouth, or 12 o'clock. In places where the moon bears 1, 2, 3, 4, or more points to the eaftward or

westward of the meridian, when it is high water on such days, the tide is said to flow on such a point; so, if the moon bear south-east, at high-water, it is said to flow south-east and north-west, or 9 o'clock; if she bears south-west, it flows south-west and north-east, or 3 o'clock; and in like manner for every other point of the moon's bearing.

From the observations of many persons, the time of high-water on the days of the new and full moon on most of the coasts of Europe, and several other places, have been collected; and those are generally put in a table, against the names of their respective places, in an alphabetical order; hence it is called the Tide Table. which is at the end of the Book.

The method generally prescribed for finding the time of high-water at any place, is contained in the following particulars:

To find the Leap Year.

Divide the given year by 4, if nothing remains, it is leap-year, but if 1, 2, or 3 remains, they shew that it is so many years after Bissextile or Leap-year, as the remainder is: thus, in the year 1806, divided by 4, gives 451, and the remainder [2] shews it is the second year after Bissextile, or Leap-year.

To find the Golden Number for any Year.

Rule. Add one to the given year, and divide the sum by 19, the remainder will be the Golden Number.

EXAMPLE.

Required the Golden Number of 1806?

By adding one to that year, it gives 1807; this divided by 19 gives 95 for the quotient, and the remainder is 2, the Golden Number for 1806.

To find the Epact for any Year.

Note. The Epact is the moon's age at the beginning of the year, or rather the 1st of March. The Epact advances 11 every year to 30, because the solar year is 11 days longer than the lunar year, and as the Epact increases, it shews the moon's age at the beginning of the year; it is here supposed that at the end of 19 years, the sun and moon make all the variety of situations they possibly can with one another, and thence begin, and go over the same again. The Golden Number at the birth of Christ was 1, which is the reason that one is added to the given year, to find the Golden Number.

Rule. Divide the given year by 19, the remainder multiply by 11, and the product will be the Epact, if it does not exceed 29; but if it does, subtract 30 from it as often as you can, and the remainder will be the Epact, for it never exceeds 29.

EXAMPLE.

EXAMPLE.

What is the Epact of the Year 1806?

1806 divided by 19, gives 95 for the quotient, and 1 remaining shews the Epact is (11) for 1806.

To find the Moon's Age.

To the Epact add the day of the month, and the Epact or number for the month; the sum, if it does not exceed 30, is her age; but if it does, subtract 30 from it as often as you can, and the remainder is her age.

NOTE. The Epact, or number for each month, is found thus: divide the number of days contained between the 1st of January and the 1st day of any month, by $29\frac{1}{2}$, the remainder will be the number for that month.

Required the Number or Epact for Sept. 1806?

The number of days contained between the 1st of January, 1806, and the 1st of Sept. are 243 days, divided by $29\frac{1}{2}$, gives 8 for the quotient, and 7 for the remainder, which is the number sought; and so for any other month.

EXAMPLE.

Required the Moon's Age, April 29, 1806?

Day of the month	29
Epact	11
Number for the month	2
	30)42(1
	30
Moon's age	12

Numbers for the months are nearly as follow:

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
In com. years	0	2	0	2	2	4	4	6	7	8	9	10
In leap years	0	2	1	3	3	5	5	7	8	9	10	11

To find the Moon's Southing on any Day of her Age.

Since the sun returns to the meridian he has left in the space of 24 hours, and the moon in about 24 hours 49 minutes; therefore, if the moon leaves the meridian at the same time that the sun does, on any day, the next day she will come to the meridian 49 minutes after him, falling back about 49 minutes every day; whence, to find the time of the moon's southing, or coming to the meridian on any day, we have this easy RULE:

Multiply the day of her age by 49, and divide the product by 60, the quotient is the hours, and the remainder the minutes afternoon when she souths. Or, which is rather easier, and in many respects sufficiently exact for the mariner's purpose; multiply the moon's

moon's age by 4, and divide the product by 5, the quotient is the hours, and the remainder multiplied by 12, gives the minutes afternoon when ſhe is upon the Meridian; but if this time exceeds 12, ſubtract 12 hours from it, and the remainder is the time of her ſouthing in the morning.

N. B. From the full moon to the change ſhe comes to the meridian, or ſouths, in the morning; but from the change to the full, in the afternoon.

EXAMPLE.

Required the Moon's Southing, Aug. 14, 1806?

The Epact is	—	11
Number for the month is		6
Day of the month	—	14
		30)31(1
Moon's Age		1 = 49 min.

Hence it appears that the moon comes to the ſouth at 49 minutes afternoon.

To find the Time of High Water on any Day of the Moon's Age at any Place.

RULE. To the time of the moon's ſouthing on the given day, add the time of high-water at the full and change, at the given place, taken from the Table; the ſum is the hour paſt noon on the given day when it is high-water at that place; and if this hour exceeds 12, ſubtract 12 from it, and the remainder ſhews the time of high water in the morning; but if it exceeds 24, ſubtract 24 from it, and the remainder ſhews the time of high-water in the afternoon.

Required the Time of High Water at Milford on the 29th Jan. 1806.

EXAMPLE I.

Epact	—	11
No. of Month	—	0
Day of Month	—	29
		30) 40 (1
Moon's Age	—	10
× by	—	49
÷ by	—	60)490 (10
Moon's South.	—	8 10 afternoon.
Time at Milford	—	6
		14 10
		12
H. W. Morning		2 10

EXAMPLE.

EXAMPLE II.

At what time will it be High Water at London, August 29, 1809?

	19)1809(95
	99
	4
× by	11
	30) 44 (
Epact	14
No. of Month	7
Day of Month	29
	50
Subtract	30
Moon's Age	20
Multiply by	4
Divide by	5) 80 (
Moon's Southing	16 Hours
Time at London	2 46
Afternoon	18 46
Subtract	12
In the Morning	6 46

So that it is High Water at 46 min. after 6 in the morning; and by adding 12 hours 24 minutes, the sum gives the time of the next High Water.

EXAMPLE III.

Required the Time of High Water at Dover, Oct. 1, 1806.

	19)1806(95
	. .
	96
	1
× by	11
Epact	11
No. of Month	8
Day of Month	1
	20
Multiplied by	49
÷ by	60)980(16
	. . .
	16.20
Dover	10.16
	26.36
	24
Afternoon	2.36

Here it is 36 min. past two o'clock in the afternoon.

EXAMPLE IV.

Required the Time of High Water at Aberdeen on the 2d of June, 1806.

Epact	11
No. of Month	4
Day of Month	2
Moon's Age	17
× by	4
÷ by	5)68(3
	. . 12
In the Morning	13.36
Time at Aberdeen	12.45
	26.21
	24.
H. W. Morning	2.21

Coming into a Port and finding that it is High Water at a certain Hour, to know when it is High Water there on Full and Change Days.

RULE. Subtract the time of high-water from the moon's southing on that day, but if required add 12 hours, the remainder will be the time of the flowing, on the full and change, at that place.

This

This method of finding the time of high-water, at times, will differ hours wide of the truth; even if the moon's fouthing be exactly found; for the floods do not always happen at the fame diftance of time from each other, but at different diftances. according to the times of the moon's age, or as the waters are acted upon by the fum or difference of the attractive forces of the fun and moon, and alfo on account of winds and ftorms, even when out of hearing; therefore pilots, and all concerned, would do well to ufe the following method, which will in general give the time of high-water nearer the truth, when the tides are not greatly influenced by the wind.

A Table fhewing the Day of the Month and Hour of the Day when it is New Moon by Astronomical Calculation.

Months.	1806. D. H.	1807. D. H.	1808. D. H.	1809. D. H.
Jan.	19 . 18	8 . 8	27 . 4	15 . 13
Feb.	18 . 3	7 . 2	25 . 21	14 . 2
March.	19 . 19	8 . 21	26 . 14	15 . 16
April.	18 . 9	7 . 14	25 . 7	14 . 8
May.	17 . 20	7 . 5	24 . 23	14 . 0
June.	16 . 4	5 . 17	23 . 13	12 . 16
July.	15 . 12	5 . 3	23 . 0	12 . 6
Auguft.	13 . 19	3 . 11	21 . 10	10 . 20
Sept.	12 . 2	1 . 19	19 . 19	9 . 8
October.	11 . 12	1 . 3 30 . 13	19 . 5	8 . 20
Nov.	9 . 24	28 . 24	17 . 15	7 . 7
Dec.	9 . 14	28 . 13	17 . 2	6 . 17

A Table of Corrections to be added to the Moon's Age to find her Southing.

Ds.	H. M.	Ds.	H. M.
1	0 . 36	16	0 . 45
2	1 . 11	17	1 . 19
3	1 . 46	18	1 . 54
4	2 . 21	19	2 . 30
5	3 . 1	20	3 . 11
6	3 . 44	21	3 . 56
7	4 . 37	22	4 . 51
8	5 . 40	23	6 . 0
9	6 . 58	24	7 . 18
10	8 . 14	25	8 . 31
11	9 . 17	26	9 . 31
12	10 . 9	27	10 . 21
13	10 . 53	28	11 . 3
14	11 . 33	29	11 . 42
15	12 . 8	29½	12 . 00

The Ufe of the foregoing Tables.

Find the day and hour of the laft new moon which happened before the day propofed; to which add the number of days elapfed, to find the moon's age.

To

To find the Time of High Water.

Look for the moon's age in the Table of Corrections, the hours and minutes opposite to which being added to the time of high-water, on the change and full days, at any place, will, if it does not exceed 12 hours, give the time of high-water there in the afternoon of the given day; but if it does exceed that number, take 12 from it, and the remainder will shew the time of high-water in the morning.

EXAMPLE I.

At what Time will it be High Water at London, April 19, 1806?

In April, I find it was new moon the 18th day; and, reckoning forward to April 19, gives 1 day for the moon's age.

Against 1, in the Table of Corrections, stand 36 minutes, to which add 3 hours, the time of high water at London on the full and change days, and that gives 3 hours 36 minutes, the time of high-water at London in the afternoon.

EXAMPLE II.

Required the Time of High Water at Dover, Aug. 13, 1808?

In October I find it was new moon the 22d day; reckoning forward from the last new moon, July 23, to Aug. 13, I find the moon's age is 20 days; against 20 in the Table of Corrections stand 3 hours and 11 minutes. This, added to 10 hours 30 minutes, the time of high-water on full and change days at Dover, gives 13 hours 41 minutes; from which I take 12, and the remainder 1 hour 41 minutes is the time of high-water in the morning at Dover on the given day.

EXAMPLE III.

What Time will it be High Water at Torbay, May 17, 1809?

By the Table it was new moon on the 14th day, and reckoning forward to the 17th, I find there are three days completely past. Against 3 in the Table of Corrections, stand 1 hour 46 minutes, which, added to 6 hours, the time of high water at Torbay, on full and change days, gives 7 hours 46 minutes, the time of high water in the afternoon on the above day.

In like manner may the time of high-water be found at any other place.

If the place be any distance east or west of Greenwich, the long. must be reduced into time; and if it be east long. at the place, subtract it from Greenwich time; but if west long. add it, to find the corresponding time at the ship, or place, remembering always to reckon the time from the preceding noon.

EXAMPLE I.

When it is Noon at Greenwich, what Time is it 60° or Four Hours to the Eastward of Greenwich?

Twenty-four hours less 4 hours is 8h A. M. on the day before at Greenwich. And 8 hours A. M. at Greenwich is noon 60°, or 4 hours E. of Greenwich.

EXAMPLE II.

What is Greenwich Time when it is Noon 75°, or Five Hours West of Greenwich?

To 0 or meridian, add 5 hours, gives 5 hours P. M. at Greenwich. And 5 hours P. M. at Greenwich, is noon 75° W. of Greenwich.

A TABLE where the Corrections are to be added to the Time of High Water on the New and Full Moon, to give the Time of High Water on any other Day.

Interval of Time.	Af. New and Full Moon	Bef. First and Third Quarters.	Af. First and Third Quarters.	Bef. New and Full Moon.	Interval of Time.
D. H.	H. M.	H. M.	H. M.	H. M.	D. H.
0. 0	0. 0	5. 6	5. 6	0. 0	0. 0
0. 6	0. 8	4. 51	5. 22	11. 51	0. 6
0. 12	0. 17	4. 37	5. 40	11. 42	0. 21
0. 18	0. 26	4. 23	6. 0	11. 33	0. 18
1. 0	0. 36	4. 9	6. 20	11. 23	1. 0
1. 6	0. 45	3. 56	6. 39	11. 13	1. 6
1. 12	0. 54	3. 44	6. 58	11. 3	1. 12
1. 18	1. 2	3. 32	7. 18	10. 53	1. 18
2. 0	1. 11	3. 21	7. 37	10. 43	2. 0
2. 6	1. 19	3. 11	7. 56	10. 32	2. 6
2. 12	1. 28	3. 1	8. 14	10. 21	2. 12
2. 18	1. 37	2. 50	8. 31	10. 9	2. 18
3. 0	1. 46	2. 40	8. 47	9. 56	3. 0
3. 6	1. 54	2. 30	9. 2	9. 44	3. 6
3. 12	2. 3	2. 21	9. 17	9. 31	3. 12
3. 18	2. 12	2. 12	9. 31	9. 16	3. 18
4. 0	2. 21	2. 3	9. 44	9. 2	4. 0

To find the Time of High Water.

From page 1. of the month in the Nau. Alm. take out the time of the phase of the moon answering nearest to the given day, which reduce to the meridian of the place by subtracting the long. of the place in time, if it be west, and adding it if it be East: then, under the nearest phase, at the top of the Table, and opposite the difference

difference between this reduced time and the noon of the given day, is the Correction to be added to the time of high water on the new and full moon at the given place, to find the time of high water on the given day.

EXAMPLE I.

Required the Time of High Water at Portsmouth, on the 13th of June, 1808.

	D.	H.	M.
The nearest phase to the 13th of June is 3d quarter	15	10	8
Day of month — — —	13		
Diff. of time before the 3d quarter —	2	10	8
Between 2d. 6ho. and 2d. 12ho. the equation is +		3	5
Flows at Portsmouth — — —		11	36
As it is past the full gives high water 2h. 41 min. A. M. =		14	41

EXAMPLE II.

What Time is it High Water at Portsmouth the 3d of July, 1808.

	D.	H.	M.
To July the 3d the nearest phase is 1st quarter June	30	17	45
July the 3d may be called — June	33		
Diff. of time after the 1st quarter — —	2	6	15
The equation for 22d. 6 ho. is +		7	56
Flows at Portsmouth — — —		11	36
High water 7 Ho. 32 P. M. = — —		19	32

EXAMPLE III.

Required the Time of High Water the 10th of July, 1808, at Halifax, Nova Scotia, Long. 63° 28′ W. *where it flows* 7H. 30M.

	D.	H.	M.	S.
Time from noon of full moon at Greenwich	7	12	3	:
Long. of Halifax 63 28 in time =	—	4	13	52
Time of full moon at Halifax — —	7	7	49	8
Given day — — —	10			
Interval of time past the full moon —	2	16	10	52
Correction from the Table for the interval =	+	1	33	
Time of high water new and full at Halifax		7	30	
High water at Halifax the 10th of July —		9	3 A.M.	

But to find the time of the next high water find the diff. of equation for the next 12 hours, which added to the time of the last high water, gives you the time required.

OF THE

LOG-LINE AND HALF-MINUTE GLASS,

AND HOW TO

CORRECT THE DISTANCE GIVEN BY THEM.

THE log is a flat piece of wood like a flounder, or of the figure of a quarter of a circle, having its circular ſide loaded with lead ſufficient to make it ſwim upright in the water. To this log is faſtened a long line of about 150 fathoms, called the log-line, which is divided into certain equal ſpaces, called knots, each of which ought to bear the ſame proportion to a nautical mile (60 of which make a degree) that half a minute does to an hour, that being the time allowed for the experiment.

They are called knots, becauſe at the end of each of them there is a piece of twine with knots in it, reeved between the ſtrands of the line; theſe pieces of twine ſhew how many knots run out in half a minute, and conſequently the ſhip's rate of ſailing per hour,

Mr. NORWOOD, and ſeveral other able mathematicians, have found that a degree of a great circle upon the earth contains about 367,200 Engliſh feet, therefore a nautical mile being $\frac{1}{60}$ part of 367,200 feet, that is, 6120 feet, and ſince half a minute is $\frac{1}{120}$ part of an hour, the length of the knot on the log-line ought to be the $\frac{1}{120}$ part of 6120 feet, or 51 feet. (In the requiſite Tables publiſhed in 1802, the ſea mile is accounted 6078 feet.) But as for the moſt part, the ſhip's way is found, by experience, to be really more than that given by the log, and as it is ſafer to have the reckoning before the ſhip than after it, therefore 50 feet may be taken as the proper length of each knot, and theſe knots ſubdivided into ten fathoms, each of five feet, which is certainly the beſt adapted for practice, and will correſpond with all the tables and inſtruments uſed in navigation, as they are decimally divided, and conſequently, the ſhip's run determined with greater eaſe and certainty. But ſome experienced commanders find, that the allowing 50 feet to a knot generally makes the ſhip a-head of the reckoning; and to avoid danger moſtly divide the log-line into knots of 7 or 7¼ fathoms of 6 feet each, to correſpond with a glaſs that runs 28 ſeconds, Others again divide the ſeconds the glaſs runs by 4, and take the quotient for the diſtance in fathoms between the knots: which laſt method I have uſed for 40 years, and always found it anſwered; but certain it is, that whatever length the knots are, the moſt convenient way is to divide them into tenths.

In hot or dry weather, the glaſs runs out faſter than in moiſt or rainy

rainy weather; therefore care ſhould be taken to try what number of ſeconds the glaſs runs.

The knots commonly begin to be counted at the diſtance of 10, 12, or 15 fathoms from the log, according to the largeneſs of the ſhip, that ſo the log may be out of the ſhip's wake when it is thrown overboard before they begin to count, leſt the eddies ſhould ſuck the log after the ſhip; and for the moſt ready diſcovery of this point of commencement, there is commonly faſtened at it a piece of red rag; that part of the line between the red rag and the log is called the ſtray-line.

The log and log-line being duly prepared and hove overboard from the lee quarter, and the line veered out (by the help of a reel, which turns eaſy, and about which it is wound) as faſt as the log will carry it away, or rather as faſt as the ſhip ſails from it, will ſhow how faſt the ſhip has ſailed in the given time, or rate of ſailing per hour.

The experiment for finding the velocity of the ſhip is called heaving the log.

Care ſhould be taken to veer out the line as faſt as the log takes it, for if the log is left to turn the reel of itſelf, the log will come home and deceive you in the reckoning.

In King's ſhips, India ſhips, and ſome others, the log is hove every hour, but in coaſters, and thoſe uſing ſhort voyages, every two hours.

Here the ſhip is ſuppoſed to move with equal velocity between the times of trying the experiment. But if the gale has not been the ſame during the whole hour, or time between heaving the log, or if there have been more ſail ſet, or any handed, that ſo the ſhip has run more or leſs in any part of the hour than ſhe did at the time of the experiment; or if it ſhould fall little or more wind at that time, there muſt be allowance made for it according to the diſcretion of the artiſt: Sometimes, too, when the ſhip is before the wind, and a great ſea ſetting after her, it will bring home the log; in ſuch caſes it is cuſtomary to allow one mile in ten, and leſs in proportion, if the ſea be not ſo great.

Care ſhould alſo be taken to meaſure the log-line pretty often, leſt it ſtretch, and deceive you in the diſtance.

The like regard muſt be had, that the half-minute glaſs be juſt 30 ſeconds, otherwiſe no account of the ſhip's way can be kept; to prove which, if there be no ſtop watch at hand, let a plummet, of any form or weight, be faſtened to a ſilk ſtring or thread, with a loop to hang on a ſmall pin or nail faſtened in any place, ſo that the plummet may ſwing freely; let it be 39⅛ inches from the end of the loop to the middle of the plummet, and the plummet cauſed to ſwing; each of thoſe ſwings will be a true ſecond of time, always counting every time it paſſes the perpendicular let fall from the pin, and every time it paſſes from the perpendicular to the utmoſt ſwing will be half-a-ſecond.

How

How to correct the Distance given by the Log-Line and Half-Minute Glass.

The distance given by the log may be wrong on three accounts. *viz.* by an error in the glass, an error in the log-line, or an error in both; for correcting of which take the following cases:

CASE I.

When the log-line is truly divided, and the glass is faulty.

RULE. Say, as the seconds run by the glass are to 30 seconds, so is the distance given by the log to the true distance.

EXAMPLE. I.

Suppose a ship runs at the rate of 7½ knots in the time the glass runs out, but measuring the glass I find it runs 34 seconds; what is the true rate of sailing?

As 34 : 30 : : 7,5 : 6,6 miles, the true distance sailed in an hour.

EXAMPLE II.

Suppose a ship runs at the rate of 6¾ knots, but measuring the glass I find it runs only 25 seconds; required the true rate of sailing?

As 25 : 30 : : 6,5 : 7,8 miles, the true distance sailed in an hour.

CASE II.

When the glass is true and log line faulty.

RULE. Say, as 50 feet is to the distance measured between knot and knot, so is the distance run by the log to the true distance.

EXAMPLE I.

Suppose a ship runs at the rate of 6¼ knots in half a minute, but measuring the space between knot and knot, I find it to be 56 feet; required the true rate of sailing?

As 50 : 56 : : 6,25 : 7 miles, the true distance sailed in an hour.

EXAMPLE II.

Suppose a ship runs at the rate of 6½ knots in half a minute, but measuring the space between knot and knot, I find it to be only 44 feet; required the true rate of sailing?

As 50 : 44 : : 6,5 : 5,72 miles, the true distance sailed in an hour.

CASE III.

When both the log-line and glass are faulty.

RULE. Multiply thrice the measured length of a knot by the distance run by the log, the product divided by 5 times the measured time of the glass will give the true distance run.

EXAMPLE

HADLEY'S
QUADRANT AND
SEXTANT.

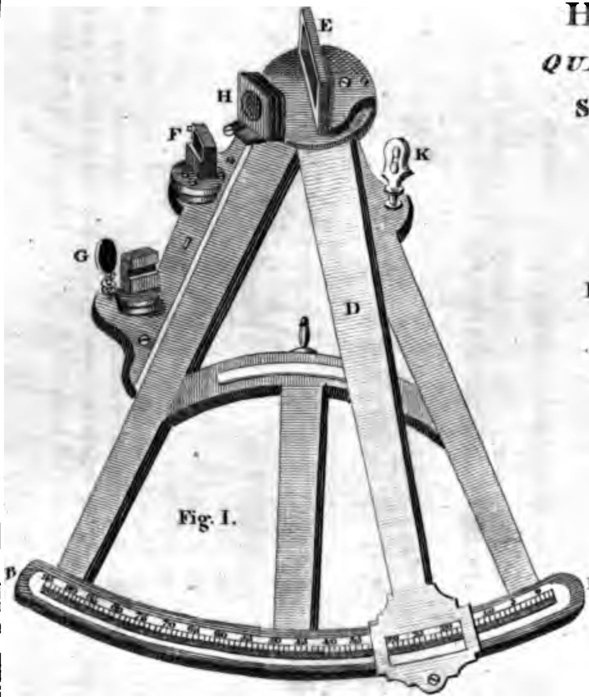


Fig. 1.

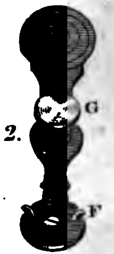


Fig. 2.

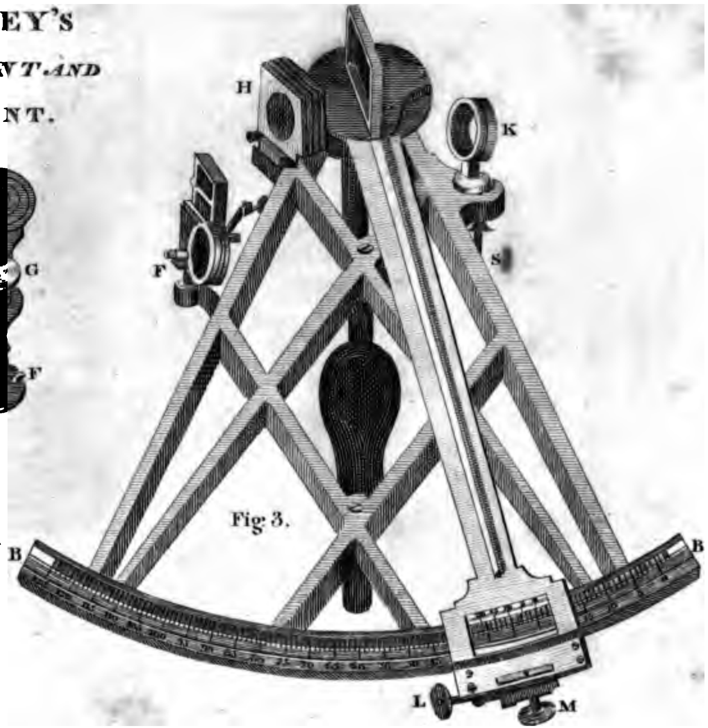


Fig. 3.

Published by J. Johnson & the rest of the Proprietors July 1, 1806.

R. Pouncy sculp.

EXAMPLE.

Suppofe a fhip runs 5 knots of a log-line of 45 feet to a knot, while a glafs of 25 feconds is running out; what is the true rate of failing?

The meafured length of a knot	—	45
Multiplied by	— —	3
Gives thrice the meafured length of a knot		135
Which multiplied by the diftance run per log		5
	Product	675

And dividing the product by 5 times the time the glafs runs, that is $5+25=125$, the quotient is 5,4, the number of miles the fhip runs per hour.

This rule is only a compound of the two former fimple ones, which is contracted a little.

When the glafs is faulty, the log-line may be divided as in the annexed Table, fhewing the length of the knots of the log-line of different glaffes.

Second of Glafs.	Length of Knots in Feet.
24	40,0
25	41,8
26	43,4
27	45,0
28	46,8
29	48,4
30	50,0
31	51,8
32	53,4
33	55,0
34	56,8
35	58,4
36	60,0

THE DESCRIPTION AND USE

OF

HADLEY's QUADRANT AND SEXTANT.

The principal Parts of the Inftruments are,

Fig. I. & III.
- The Index D
- The Index Glafs E
- The Horizon Glaffes G and F
- The Dark Glaffes, or Screens, H.
- The Sight Vanes K and G

The graduated arch BB of the Quadrant contains only 45 degrees,

grees, or the 8th part of a circle, but it is to be counted as 90°, and so divided, becaufe, by the double reflection, the angle is doubled.

The divifions run 0, 10, 20, &c. to 90, as in the figure; each degree is divided into 3 parts, of 20 minutes each, which, by the help of the vernier, or divifions on the index, is again fubdivided into minutes of a degree, thus:

The index D is a flat bar moveable on the centre of the inftrument; that part of the index that flides over the graduated arch, having the firft and laft divifions thereon correfponding to thofe on the arch, is called the Vernier or Nonius, and which divides every fub-divifion on the arch in minutes: thus, 7 divifions on the nonius being divided into 20 parts, it is evident the difference between the firft divifion on the arch and on the nonius is $\frac{1}{20}$ of one of the fub-divifions on the arch, or 1 minute, becaufe 7° there is divided into 21 parts, being 1 in 20 more than on the arch. The difference of the two firft divifions will be 2′, and the difference of the three firft 3, and fo on; hence it will arife, that in whatever divifions on the vernier and arch cut one another the neareft, the vernier will indicate how many minutes above the next fub-divifion according as it is numbered to right or left thereof. On the bottom of the index, againft the back of the arch, is a fcrew, made to fix faft the index when required.

The arch, as before obferved, is divided into 90 degrees, numbered, ◇ 10, 20, 30, &c. and each degree into 3 parts, each 20 minutes, and is to be read thus: 1d.—1d.—20m.—1d. 40m.—2d.—2d. 20m.—2d. 40m.—3d. &c. obferving to read to the divifion that the ◇, or diamond like point of the nonius laft paffed over; then the nonius will give the number of minutes more, to be added to the divifion laft paffed by the nonius. Thus, fuppofe the ◇, or △ of the nonius has paffed over 15 degrees and two parts, or 15d. 40m. and ftands fomewhere between 15d. 40m. and 16d. then obferve what divifion or line on the nonius coincides with any divifion or line on the arch, that number on the nonius will be the minutes to be added to 15d. 40m. Suppofe 15 on the nonius touches fome divifion on the arch, then 15m. muft be added to 15d. 40min. and the angle or altitude meafured will be 15d. 55m.

The index glafs E. is a piece of glafs truly ground, filvered on the back, and fixed in a brafs frame, perpendicular to the index; its ufe is to receive the rays proceeding from any object, and reflect them to the horizon glaffes F and G; at the back of the brafs frame of this glafs are two fcrews, ferving to adjuft the frame perpendicular to the index.

The horizon glaffes F F are fmaller pieces of ground glafs, one part of which is filvered, and the other part open or unfilvered, in order to look at an object through it; thefe are fet in frames and placed perpendicular on the limb at F and F; their ufe is to receive the rays of any object reflected from the index glafs, and again to reflect thofe rays to the eye through the holes of the fight vanes K and G.

To

To adjust the Quadrant or Sextant for the Fore Observation.

First, the index glass must be perpendicular to the plane of the quadrant, which, if not, you may thus discover: hold the plane of the quadrant in an horizontal position, with the index glass near the eye; look right down the quadrant in such a manner as to see the arch of the quadrant direct, and at the same time reflected by the index glass; then, if the arch seen direct, together with its reflected image, appear to be in one line; the index glass is truly adjusted; if not, it must be rectified by means of the screws placed at the back of the index glass: it is easy to discover which way the inclination is, by pressing the index glass with your thumb while you observe the arch.

Secondly, The axis of the horizon glass must be parallel to the axis of the index glass, if not the error is easily discovered and rectified in the fore horizon glass when the index is adjusted, thus: bring ⏀ on the nonius nearly to ⏀ on the graduated arch, and look directly through the sight vane at the moon or any bright star, so as to see the reflected image in the horizontal glass, and the object at the same time through the unsilvered part; then move the index backwards and forwards slowly, and observe if both images coincide or pass behind one another, which, if they do, the axis of both are parallel; which if not, you should nicely adjust by the two screws placed on the top block of the horizon glass, and by the lever on the back of the quadrant or sextant.

But to adjust the instruments by the horizon, hold the instrument horizontal, if the real horizon and that reflected in the quicksilvered part of the horizon glass coincide, it is adjusted; if not, adjust by the two screws on the top of the block of the horizon glass, and then with the instrument vertical by the lever on the back Fig. II. remembering to place ⏀ on the graduated arch to ⏀ on the instrument before you begin.

If a small piece of coloured glass set in brass (which I first fixed to a quadrant in 1790) be made to turn round to the sight vane occasionally to guard the eye, and the screens turned back, the same correction may be made by using the sun instead of the moon or star.

To adjust the Quadrant for the Back Observation.

Find the dip of the horizon for the elevation of your eye in Table VIII. double the dip, and advance the index D as many minutes before 0 degrees on the arch of the quadrant, as are equal to double the dip: screw your index fast: shift the screens for the back observation:—hold the plane of the instrument upright with the arch downwards, look through the vane G, and if the horizon line seen through the unsilvered part of the back horizon glass G coincide with the reflected image of the same, seen through the silvered part of the glass, the quadrant is rightly adjusted; if not, slacken the screw in the middle of the lever behind the back horizon glass G, and turn the glass backwards or forwards, as re-

 quired,

quired, till the horizon lines coincide, then tighten the ſcrew, and the quadrant is adjuſted.

Another way to adjuſt for the Back Obſervation.

Take the altitude of the ſun's lower limb, by the fore obſervation, when he is nearly on the meridian; then ſhift the ſcreens as quick as poſſible for the back obſervation: if the upper limb of the ſun be level with the horizon (allowing for double the dip) the quadrant is rightly adjuſted; if not, move the ſcreens of the back horizon glaſs G till it is ſo; repeating the operation till you find the quadrant truly adjuſted.

To take the Altitude of the Sun by the Fore Obſervation.

The ſun's image at any time, when not much obſcured by clouds, may be ſeen as reflected from the unſilvered part of the horizon glaſs, by looking through the hole in the ſight vane; having put the ſcreens down to guard the eye, hold the inſtrument vertical, and, turning towards the ſun, direct the ſight to that part of the horizon beneath the ſun, and moving the index, you may bring down the red image of the ſun towards the horizon; if the ſun's image ſhould be faint you may turn back the ſcreens, and you cannot miſs it.

Having brought down the ſun's image near the horizon, ſwing the quadrant backwards and forwards, making your eye the centre of motion, and keep moving the index, at the ſame time, till the ſun's lower edge juſt touches the horizon, and you will have the apparent altitude of the ſun's lower limb upon the arch of the quadrant at that inſtant. But this altitude is greateſt at twelve o'clock, when the ſun is on the meridian, from which the latitude is determined; but this apparent altitude requires the following corrections:

The index error, if any, to be added or ſubtracted.

The dip of the horizon.

The ſun's ſemi-diameter and refraction.

Theſe corrections are neceſſary to find the true altitude of the ſun's centre nearly, the correction of the ſun's parallax being ſo ſmall, that it may always be neglected in determining the latitude.

The back obſervation is managed the ſame as the fore obſervation, only your back muſt be turned towards the ſun, and the ſcreens ſhifted to the back horizon glaſs, remembering to ſubtract the ſun's ſemi-diameter (if the apparent lower limb be taken) and add the dip, ſubtracting the effect of refraction, and you will have the altitude of the ſun's centre.

The correction for the index error is thus: Turn down the ſmall knob of braſs placed on the limb, to hinder the index from going off the arch, as it may be in the way. This correction may be accurately eſtimated by taking the diameter of the ſun, or any object before and behind ⊕ on the arch; that is, bring the upper limb of the object to coincide with the lower, and note

note the angle, then take it on the extra arch, as it is called; that is, bring the lower limb to coincide with the upper, and note the angle, half the difference of these two angles will be the true correction of the index error.

EXAMPLE.

Suppose the sun's diameter measures 36 on the arch, and 28 on the extra arch. The difference is 8', half which is the error to be subtracted, because the diameter measures more on the arch, or gives the sun's diameter too much, but had the extra arch given the greater angle, the error would have been additive.

To take the Altitude of the Moon.

The moon's altitude may be either taken by the fore or back observation, exactly in the same manner as the sun's altitude, only here you must bring the edge of the moon into contact with the horizon, which is round and well defined, whether that be the upper or under edge: the corrections to be applied to the observed altitude are as follow:

The index error, as before directed, if any; the dip to be subtracted in the fore observation, and to be added in the back observation; the semidiameter to be found in the nautical ephemeris for every noon and midnight, at Greenwich; if very great accuracy is required, this semi-diameter must be corrected for the intermediate time: which being added to, or subtracted from, the observed altitude, will give the apparent altitude of the centre; and the moon's horizontal parallax for every noon and midnight, at Greenwich, is to be found in the Nautical Ephemeris. This must be corrected for the intermediate time; then take the proportional logarithm of the moon's horizontal parallax out of the Nautical Almanac, increase its index by 10, and subtract the log. co-sine of the moon's apparent altitude from the sun; the remainder will be the proportional logarithm of her parallax in altitude; from which take the moon's refraction (Table VII.) and the remainder will be the correction of the moon's altitude, which being added to her apparent altitude, will give the true altitude of her center.

To take the Altitude of a Star by the Fore Observation.

Set the index at ⓪, and holding the plane of the quadrant vertical, direct the sight to the star, and at the same time look for the reflected image of the star in the silvered part of the horizon glass; move the index a little, which will separate the reflected image from the direct image, the former will be easily distinguished from the latter by its motion, when you stir the index; continue to advance the index, and at the same time follow the reflected image of the star with your eye, directing your sight lower and lower, and changing the position of the quadrant or sextant, as the image

of the star descends, till you have brought it down to the horizon; the index will then shew the observed altitude of the star. The corrections to be applied to the observed altitude of the star are: the index error, the dip (these two give the apparent altitude); the refraction gives the true altitude; the fixed stars have neither semidiameter nor parallax worth notice.

In taking the altitude of a star, or the moon, by night, always get as near the water as possible; in moderate weather a grating may be flung over the ship's side, and an observer sit upon it to take the altitudes; the same may be done to take the altitude of the sun in an hazy horizon; for the nearer the eye is to the surface of the water, the nearer the true horizon will be to the eye.

Advice to Seamen in the Choice of their Quadrants and Sextants.

The joints of the frame must be close, without the least opening or looseness, and the ivory on the arch and nonius inlaid and fixed, so as not to rise at the ends, nor above the plane of the instrument; all the divisions on the arch and nonius must be exceeding fine and straight, so that when the index or nonius is set to any division on the arch, the divisions on the line that coincide may appear distinct, for only the first and last line on the nonius will coincide with the other lines upon the arch, if the quadrant is well divided; likewise try in different parts of the arch, if the nonius, or index plate, cuts regularly in order with those on the arch: if they do not, the divisions are bad, and the quadrant ought to be rejected.

Again, look into the great speculum or index glass slant-ways, holding it about ten or twelve inches from the eye, and observe the image of some distant object; if the image appears clear and distinct in every part of the glass, the speculum is good; but if it appears notched, or drawn with small lines, the glass is veiny, and must be rejected, if more images than one of the same object are seen, it shews that the two surfaces are not ground parallel; the other speculum may be examined in the same manner.

Observe the sun, or a candle, through the dark glasses severally, holding the glass about eight or ten inches from the eye; if they are veiny, the object will appear notched at the edges, but if clear and well define', the glasses are good.

Quadrants, like watches, may appear well to the eye, and yet be good for little; it is therefore much better to give two guineas and an half, or three guineas, for a good one, that will last a man for life, than purchase those wretched instruments, made up at a low price, which cannot be depended on.

The surprizing improvements made in Navigation since the year 1767, when the first Nautical Almanack was published by Dr. Maskelyne, the present Astronomer Royal, are beyond the most sanguine expectations; and though several nations have contributed towards this important end, the English have (by the encouragement held out by Parliament, and the great improvements

made in nautical inftruments an clculations) furpaffed them all; fo that by the help of the imprve fextant, the Nautical Almanack, and the Tables containecin his book, a fkilful and expert obferver can determine the longtuc to a degree of accuracy that people unacquainted with the opraton would fcarcely think poffible.

Hadley's fextant is conftructe on the fame principles as the quadrant; but as it is ufed to meafre the angular diftance between the fun and moon, or the moor nd a ftar, in order to determine the longitude, the arch is exteied to 120°, for the purpofe of meafuring their diftance when greater than 90°; it is alfo provided with fome appendages n generally annexed to a quadrant, in order to take the obfervatiowith greater accuracy.

On the adjoining plate is refented a fextant, the frame of which is generally made of bras the arch BB is divided into 120°, each degree into three parts, oourfe equal to 20 minutes, which are again fubdivided by the nous into every half minute, or 30 feconds; every fecond divifiomr minute, on the nonius, is cut longer than the intermediate o; the nonius is numbered at every fifth of thefe longer divifions, m the right towards the left, with 5, 10, 15, and 20, the firft dion towards the right hand being to be confidered as the index dfion.

This is the general way of aduating fextants; but for obtaining greater accuracy, fome arivided as follow: the arch contains 120°; each degree is fubdivd into 4, of courfe equal to 15′, which are again fubdivided bhe nonius into 15″; every fourth divifion or minute of the nos, is longer than the intermediate ones; the nonius is numberedevery fifth of thefe long divifions, from the right towards the le with 5, 10, 15; the firft divifion towards the right hand is to confidered as the index divifion. The prefent mode of dividin e nonius of the fextant is thus: (beginning from the right harowards the left) by taking fifteen divifions on the nonius, equal ourteen on the arch, confequently one divifion on the arch will eed one on the nonius by $\frac{1}{15}$, that is, by $\frac{1}{4}$ of a minute, where thegrees on the arch are fubdivided into $\frac{1}{4}$, equal to 15 minutes.

The nonius, till very latelyas divided as the quadrant.

In order to obferve with aacy the contact of the limbs of any two objects, an adjuftingew, L, is added to the index, by which it may be moved with ater regularity than it can by the hand; but this fcrew does not until the index is fixed by the finger-fcrew M. Care fhoul taken not to force the adjuftingfcrew when it arrives at eithextremity of its adjuftment. When the index is to be moved anynfiderable quantity, the fcrew M, at the back of the fextant, mbe loofened; but when the index is brought nearly to the divificequired, this back fcrew fhould be tightened, and the index movgradually by the adjufting-fcrew.

N. B. Many quadrants han adjufting-fcrew.

In

In many sextants the lower pt of the index glass, or that nearest the frame, is silvered as usual and the back surface of the upper part painted black; also a screen is fixed at the base of the index glass, turning on its axis, and may be placed over the silver part when the sun's rays are strong in which case the image is reflected from the polished surface of the upper part, and the error, which might probably arise from the planes of the glasses not being parallel, is thereby avoided.

There are several coloured glass at H, each of which is set in a different frame, turning on a centre; they are used to screen the eye from the brightness of the solar rays, and the glare of the moon, and may be used separately or together, as occasion requires.

There are other such glasses placed behind the horizon glass at F, to weaken the rays of the sun or moon when they are viewed directly through the horizon glass; the paler glass is sometimes used in observing altitudes at sea, take off the strong glare of the horizon.

The sextant is furnished with plain tube, without any glasses; and to render the objects still more distinct, it has two telescopes, one representing the objects erect or in their natural position, the other shewing them inverted; has a large field of view, and other advantages; a little use will soon accustom the observer to the inverted position, and the instrument will be as readily managed by it as the plain tube alone. By a telescope the contact of the images is more perfectly distinguished; and by the place of the images in the field of the telescope it is easy to perceive whether the sextant is held in the proper plane for observing. By sliding the tube that contains the eye-glasses in the inside of the other tube, the object is suited to different eyes, and made to appear perfectly distinct and well defined.

The telescopes are to be screwed into a circular ring, at K; this ring rests on two points against an exterior ring, and is held thereto by two screws; by turning one and tightening the other, the axis of the telescope may be set parallel to the plane of the sextant. The exterior ring is fixed on a brass stem that slides in a socket, and by means of the screw, at the back of the sextant, it may be raised or lowered so as to move the centre of the telescope to point to that part of the horizon glass which shall be judged the most fit for observation.

A circular head, containing a plate, in which there are three coloured glasses, and a fourth that is open, sometimes accompanies this sextant. This head is be screwed on the eye-end of the tube, or on that of either telescope. The edge of the plate projects a little beyond the head on one side, and is moveable by the finger, so that the open ring or any of the coloured glasses, may be brought between the eye-glasses of the telescope and the eye.

To these are added, a small screw-driver to adjust the screws, and

and a magnifying glaſs to read off the obſervation with greater accuracy.

The Adjuſtments of a Sextant are to ſet the index and horizon-glaſſes perpendicular to the plane of the inſtrument, and their planes parallel to each other; by the ſame method as the quadrant, only ſcrewing on the plain tube or teleſcope; alſo to ſet the axis of the teleſcope parallel to the plane of the inſtrument; each of theſe particulars muſt be examined before an obſervation is taken, and the adjuſtments, if requiſite, be made.

For correcting the index error, ſee the rules for adjuſting Hadley's Quadrant.

To ſet the Axis of the Teleſcope parallel to the Plane of the Sextant.

In meaſuring angular diſtances, the line of ſight, or axis of the teleſcope, ſhould be parallel to the plane of the inſtrument, as a deviation in that reſpect will occaſion a conſiderable error in the obſervation; and this is moſt ſenſible in large angles. To avoid which, an inverted teleſcope is uſed, in whoſe field there are placed two wires parallel to each other, and equidiſtant from the centre; to which are ſometimes added two others, at right angles to theſe, but parallel to each other. By means of theſe wires the adjuſtment may be made thus: ſcrew on the teleſcope, and turn the tube containing the eye glaſs, till the wires are parallel to the plane of the inſtrument; then take two objects, as the ſun and moon, or the moon and a ſtar, whoſe angular diſtance muſt not be leſs than 90°, becauſe the error is more eaſily diſcovered when the diſtance is great; bring them exactly into contact on the wire which is neareſt the plane of the inſtrument, and fix the index; then, by altering a little the poſition of the ſextant, bring them to appear on the wire fartheſt from the plane of the inſtrument; if they remain ſtill in contact, the axis of the teleſcope is parallel to the plane of the ſextant; but if the limbs of the two objects appear to ſeparate at the further wire, it ſhews that the object-end of the teleſcope inclines towards the plane of the ſextant; this muſt be rectified by tightening the ſcrew neareſt the ſextant, which is attached to the ring that holds the teleſcope, having previouſly ſlackened the ſcrew fartheſt from it. If the images overtop each other when brought to the wire fartheſt from the ſextant, the object end of the teleſcope is inclined from the plane of the ſextant, and muſt be rectified by ſlackening the ſcrew neareſt the ſextant, and tightening the other. Repeat this operation till the contact be rendered perfect on both wires, the axis of the teleſcope will then be truly adjuſted.

To obſerve the angular Diſtance between the Sun and Moon.

Screw on the inverted teleſcope, placing the wires parallel to the plane of the inſtrument; then turn down the ſcreens, according to the brightneſs of the ſun; place the index at O on the arch, and if the ſun's image be very bright, turn up the ſcreen before the hori-

zon

zon glafs, and with the fcrew S, rife the telefcope to the tranfparent part of the horizon glafs. Having done this, hold the fextant fo that its plane may pafs through the two objects: if the fun be to the right hand of the moon, the fextant is to be held with its face upwards; but if it be to the left hand, the face is to be held downwards. With the inftrument in this pofition, look directly at the moon through the telefcope and move the index forward, till the fun's image is brought nearly in contact with the moon's neareft limb; then fix the index by the fcrew under the fextant, and make the contact perfect by means of the adjufting-fcrew; at the fame time move the fextant flowly, making the axis of the telefcope the centre of motion, by which means the objects will pafs each other, and the contact be more accurately difcriminated. The index will fhew the obferved diftance of the fun and moon's neareft limbs, which you will read off with a magnifying glafs.

Second Method.

It will perhaps be more eafy for thofe who are not accuftomed to make obfervations of this kind, to find the diftance nearly, and fetting the index forward to it, to look directly towards the moon, holding the inftrument as before; the fun will then appear nearly in contact with it, and is to be made perfect by the method abovementioned. In the Nautical Ephemeris, the diftance of the fun and moon is fet down for every three hours of time at Greenwich, on fuch days as the moon is not more than 120°, nor lefs than 40° diftant from the fun, and may be found for any intermediate time by taking proportional parts; from these diftances you may compute roughly their diftance at the time of obfervation, thus: Turn the fhip's longitude into time by Tab. XVI. and add it to the time of obfervation, if the longitude be weft, but fubtract it if the longitude be eaft, the fum or difference will give the time at Greenwich; then, by the Ephemeris, find the diftance nearly at that time, from which fubtract 30 minutes for the fun and moon's femi-diameters, and the remainder will give the diftance of their neareft limbs at the time of obfervation.

If a number of obfervations are to be taken, the following method will not be found unacceptable: Having brought the objects into contact, as before directed, and noted down their apparent angular diftance, advance or draw back your index two or three minutes, according as the objects are receding or approaching, and wait till they again come into contact, repeating the operation as often as judged neceffary, ufing the mean of all the obfervations to determine the longitude. This method will be found eafy and accurate.

NOTE.—The contact of the limbs muft always be obferved in the middle, between the parallel wires.

To obferve the Diftance between the Moon and a Star.

Turn down the lighteft fcreen before the index glafs, and direct the telefcope to the ftar, holding the fextant in its proper pofition, as

as before directed; then move the index forward, till the reflected image of the moon is seen in the telescope; by moving the instrument slowly up and down, the moon will appear to rise and fall by the star. The round and well defined limb of the moon, whether it be nearest or furthest from the star, must be brought into contact with it. When the object to be seen by reflection is to the right hand of that to be seen by direct vision, the instrument is held with its face upwards; but when the object to be seen by reflection is to the left hand of that seen directly, the instrument is held with its face downwards. Having brought the objects into contact, the nonius will shew the observed angular distance.

If the distance between the moon and one of the stars set down in the Ephemeris for finding the longitude, is to be observed, their distance may be roughly calculated as before directed, to which set the index; then look through the telescope, and direct the sight to the star, which is generally a bright one, and lies in a line nearly perpendicular to the horns of the moon, either to the eastward or westward, as denoted in the Ephemeris; then, holding the instrument in the plane of the two objects, give it a slow motion up and down, and if the moon's image come in the field of the telescope, it is a proof you have taken the right star, as no other in that direction will correspond in distance to it.

After the distance is observed between the sun and moon, by a sextant or quadrant, there still remains to be made some corrections to obtain the true distance; the corrections are those for parallax, refraction, and semi-diameter.

The dip of the horizon is an angle made with the height of the eye of the observer and the visible horizon, and which makes the angle of celestial objects appear higher than they really are by the amount of the correction found in Table VIII. and which is to be subtracted from all altitudes.

PARALLAX.

The parallax of the sun and moon is the *difference of the altitude* of either object, if observed at the same moment of time from the *centre*, and from the *surface* of the earth. The parallax of the heavenly bodies is greatest when in the horizon; hence called the horizontal parallax. That of the moon is set down in the Nautical Almanack for every noon and midnight, but may be found for any intermediate time by taking proportional parts. The sun's mean parallax being only 8″.6, is seldom attended to in nautical calculation, except when his altitude is taken to determine the true time, or the angular distance to determine the longitude. The stars, on account of their great distance from the earth, have no sensible parallax; the parallax of the sun and moon causing them to appear lower than they really are, it is evident this correction must be added to the apparent altitude of the sun and moon, in order to obtain their true altitude. This will be better illustrated by the plate facing page 146. Let C represent the centre of the

T earth;

earth; a, o, e, part of the moon's orbit; b, d, g, part of the ſun's orbit; l, k, part of the ſtarry heavens. Now, to a ſpectator at m, upon the ſurface of the earth, let the moon appear at e, in the horizon of m, and it will be referred to f; but if viewed from the centre c, it will be referred to h. The difference between theſe places, or the arch f, h, is called the horizontal parallax, and the angle m, e, c, the paralactic angle. The parallax will be greater or leſs, according to the diſtance of the objects from the earth; thus, the parallax f, h, of e, is greater than the parallax f, n, of g, and with reſpect to the ſame object, it is evident when it is in the horizon, the parallax is greateſt, and that it diminiſhes as the object approaches the zenith, where it vaniſhes. Thus the horizontal parallax of e and g is greater than the parallax in altitude of o and d; but the objects a and b, as ſeen from m, the ſurface, or c, the centre, appear in the ſame place, l, or the zenith.

Having the earth's ſemi-diameter, and the parallax of any of the planets, their diſtance may be found thus: As the tangent of the parallax : is to the earth's ſemi-diameter in miles : : ſo is radius : to the diſtance.

Having the diſtance, the parallax in altitude is found thus: As the diſtance : is to radius : : ſo is the earth's ſemi-diameter : to the tangent of the parallax.

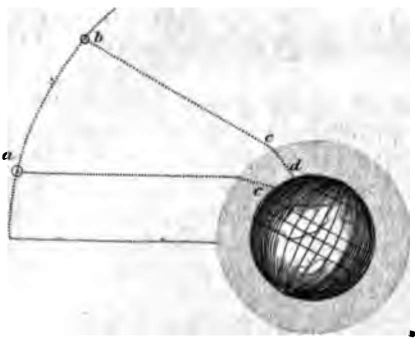
REFRACTION.

From various experiments it hath been found that the rays of light paſſing through the atmoſphere, are bent out of their ſtrait courſe into an elliptic curve-line, from whence it follows, that all heavenly bodies, except when they are in the zenith, appear higher than they ought to do, and the more ſo the nearer they are to the horizon, where they are nearly 33 miles. This apparent elevation of the heavenly bodies above their true height is called the Refraction, therefore all apparent altitudes obſerved, muſt (after the dip has been allowed for) be reduced to their true altitudes by the correction found in Table VII. which muſt be ſubtracted from the apparent altitude, or added to the zenith diſtance, in order to obtain the true altitude.

Now, ſince parallax makes all objects appear lower than they really are, and refraction makes them appear higher than they are, it is evident that the true altitude of an object cannot be obtained without correcting the obſerved altitude for the difference of theſe two ſums.

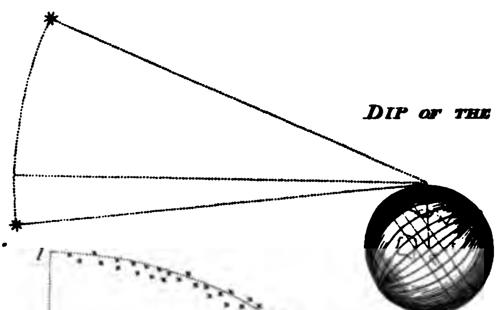
SEMI-DIAMETER.

The moon's ſemi-diameter is ſmalleſt when in the horizon, and increaſing as ſhe approaches the zenith, where it is greateſt; as ſhe is then nearer the ſpectator by the earth's ſemi-diameter. This augmentation is ſet down in Table X. Another reaſon of the apparent augmentation and diminution of the moon's ſemi-diameter is, that ſhe moves round the earth in an orbit not circular, but elliptic,

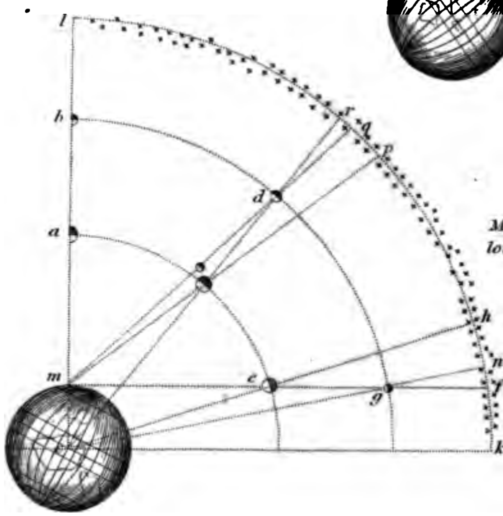


REFRACTION.

The Rays of Light passing through the Atmosphere make Objects appear higher than they are.



DIP OF THE HORIZON.



PARALAX.

Makes Objects appear lower than they are.

Penny sculp.

Published by J. Johnson & the rest of the Proprietors July 1.1806.

elliptic, and is conſequently, at different parts of her orbit, nearer to, or farther from the earth, which occaſions an apparent augmentation or diminution of her ſemi-diameter; on which account her ſemi-diameter and horizontal parallax for every noon and midnight are ſet down, page 7, of the month, in the Nautical Almanack, and may be found for any intermediate time by taking proportional parts.

It is evident, that to obtain the true angular diſtance, the obſerved diſtance muſt be corrected for the ſemi-diameter of the objects. If the neareſt limbs of the ſun and moon are obſerved, the ſum of the ſemi-diameters muſt be *added*; if the furtheſt limbs are obſerved, the ſum muſt be *ſubtracted* from the obſerved diſtance, to obtain the diſtance of their centres. The ſame rules hold good in reſpect to adding or ſubtracting the moon's ſemi-diameter, according as her neareſt or furtheſt limb is uſed when the obſervation is made between the moon and a ſtar, obſerving that the ſtar has no ſemi-diameter.

To work an Obſervation, or to find the Latitude of a Place, by the Tables of the Sun or Star's Declination, and the Zenith Diſtance.

The latitude of any place is its diſtance from the equator, either north or ſouth, counted in degrees, &c. upon an arch of the meridian, contained between the zenith and the equator.

The zenith is that point directly over our heads, and is 90 degrees diſtant from the horizon.

The zenith diſtance is the diſtance of any object from the point directly over our heads, which is always the complement of the altitude; it is ſaid to be ſouth, if the ſun or ſtar be ſouth, and north, if the ſun or ſtar be north of the obſerver.

To the obſerved altitude add the difference between the ſemi-diameter and the dip, the ſum will be the apparent altitude of the ſun's centre; but muſt be ſubtracted if a back obſervation is uſed.

From the apparent altitude ſubtract the refraction, the remainder will be the true altitude of the ſun's center: this being ſubtracted from 90 degrees, gives the true zenith diſtance, with which, and the declination, the latitude is found by the following rules.

See Globe, facing page 45.

NOTE. For the dip and refraction, ſee Tables 8 and 7.

1ſt. When the ſun or ſtar is in the zenith, the declination is the latitude; and is of the ſame name as the declination, north or ſouth.

2d. When the ſun or ſtar is on the equator, conſequently hath no declination, the zenith diſtance is the latitude of the place: if the zenith diſtance be ſouth the latitude is north; but if north, the latitude ſouth.

3d. When the zenith diſtance is north, and declination north, if they be both equal, you are on the equator, therefore in no latitude.

4th. When the zenith diſtance is ſouth, and declination ſouth, then, if the zenith diſtance is equal with the declination, you are on the equator.

The foregoing need no examples.

1ſt. But, when the zenith diſtance is ſouth, and the declination north, the declination added to the zenith diſtance gives the latitude north.

2d. When the zenith diſtance is north, and the declination ſouth, the declination added to the zenith diſtance gives the latitude ſouth.

3d. When the zenith diſtance is ſouth, and the declination ſouth, if the zenith diſtance is more than the declination, ſubtract the declination from it, and the remainder gives the latitude north.

4th. When the zenith diſtance is north, and the declination north, if the zenith diſtance be more than the declination, ſubtract the declination from the zenith diſtance, the remainder is the latitude ſouth.

5th. When the zenith diſtance is north, and the ſun hath north declination, the zenith diſtance being leſs than the declination, ſubtracting the zenith diſtance from the declination, gives the latitude north.

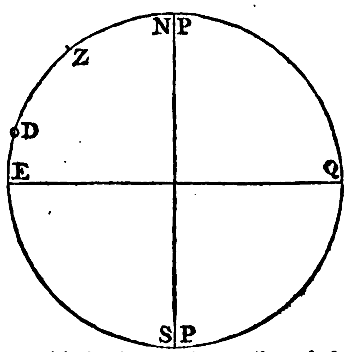
6th. When the zenith diſtance is ſouth, and declination ſouth, if the zenith diſtance is leſs than the declination, the zenith diſtance ſubtracted from the declination gives the latitude ſouth; for it is plain in theſe two laſt caſes, the obſerver is between the ſun and equator.

The preceding ſix rules are exemplified in their regular order below.

EXAMPLE I.

Suppoſe, on the 4th May, 1806, the altitude of the ſun's lower limb to be 56° 30′ ſouth, the eye being elevated 16 feet above the ſurface of the ſea. Required the lat. in?

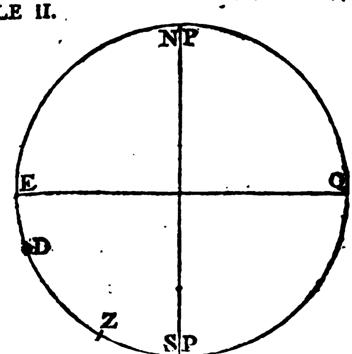
		°	′	″	
Obſ. alt. ſun's l. l. -		56	30	0	
Semi-dia. 16 0 } Dip - 4 0 }	Dif. add.	0	12	0	
Sun's apparent altitude		56	42	0	
Refraction ſubtract.		0	1	0	
Sun's true altitude -		56	41	0	
		90	0	0	
Zenith diſtance -		33	19	0	South.
Declination added -		15	51	0	North.
Latitude - - -		49	10	0	North.



With the chord of 60 deſcribe a circle to repreſent the meridian; through the center draw the diameter EQ, to repreſent the equator, and at right angles thereto, another diameter; mark the upper end, NP. for the north pole, and the lower, SP. for the ſouth pole; ſet off the declination, 15° 55′, taken from the line of chords, from E to D; take from the line of chords the zenith diſtance, 33° 19′, and ſet it off from D to Z. Then will EZ meaſure on the line of chords, 49° 10′, the latitude required.

EXAMPLE

EXAMPLE II.

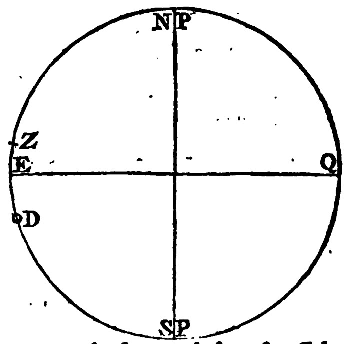


Suppose, on the 14th Jan. 1806, the meridian altitude of the sun's lower limb was found to be 46° 20′ north, the elevation of the eye being 16 feet. Required the latitude?

		° ′ ″
Sun's observed altitude		46 20 0 North.
Semi-dia 16′ 0″		
Dip - 4 0	Add	0 12 0
Diff. 12 0		
Apparent altitude -		46 32 0 North.
Refraction - -		0 1 0
Sun's true altitude -		46 31 0
		90 0 0
Zenith distance -		43 29 0 North.
Declination -		21 23 0 South.
Latitude - -		64 52 0 South.

Draw the figure as before; take the declination, 21° 20′, from the line of chords; set off from E towards the south pole, to D; take the zenith distance on the line of chords, and set it from D to Z; then will EZ, measured on the same line of chords, be the latitude required.

EXAMPLE III.

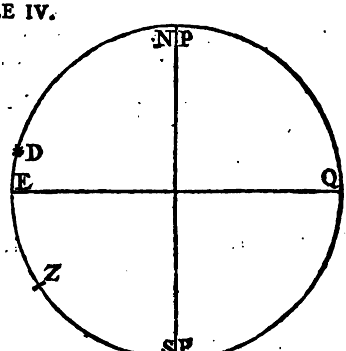


Suppose, on the 20th Jan. 1806, the meridian altitude of the sun's lower limb to be 42° 30′ south, the eye being elevated 20 feet above the water. Required the lat.

Sun's observed altitude		42 30 0 South.
Semi-dia. 16′ 0″		
Dip - 4 0	Diff.	0 12 0
Sun's apparent altitude		42 42 0
Refraction - - - - -		0 1 0
Sun's true altitude -		42 41 0
		90 0 0
Zenith distance -		47 19 0 South.
Declination - -		20 12 0 South.
Latitude - - -		27 7 0 North.

Draw the figure as before; set off the declination, 20° 12′, from E towards the south pole to D. Secondly, set off the zenith distance, 47° 19′, contra from D towards the north, to Z; then will EZ measure on the line of chords 27° 7′, the latitude.

EXAMPLE IV.



Suppose, in 1806, the altitude of the star Aldebaran, when on the meridian, be found 40° 27′ north, when the decl. is 16° 6′ 35″ north, the eye being elevated 20 feet above the sea. Required the lat?

	° ′ ″
Observed altitude -	40 27 0
Dip for 20 feet -	0 4 0
Apparent altitude -	40 23 0
Refraction -	0 1 0
Star's true altitude -	40 22 0 North.
	90 0 0
Zenith distance -	49 38 0
Star's declination -	16 6 35
Latitude -	33 32 25 South.

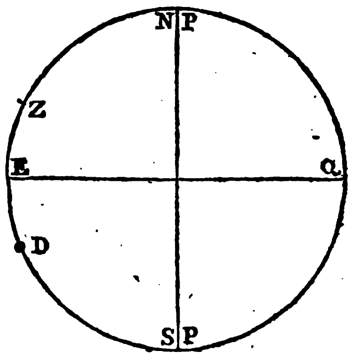
Draw the figure as before; set off the star's declination, 16° 6′ 35″ from E to D; next

D; next set off the zenith distance 49° 38′, from D to Z; then will ZE, measured on the line of chords, be 33° 32′ 25″, the latitude required, which is south.

EXAMPLE V.

Suppose the sun's true meridian altitude to be 64° 20′ south, and his declination 14° 20′ south, the latitude is required?

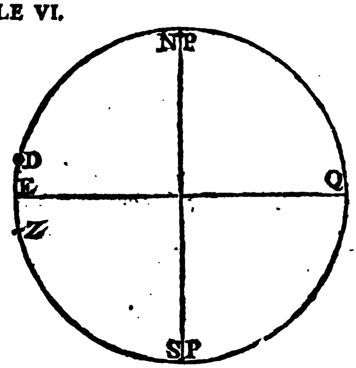
	° ′ ″	
Sun's true merid. alt.	64 20 0	
Zenith distance -	25 40 0	South.
Sun's declin. subtract	14 20 0	South.
Latitude -	11 20 0	North.



EXAMPLE VI.

Given, the true altitude of the sun's center, 64° 20′ north, and the sun's declination, 14° 20′ north. Required the latitude?

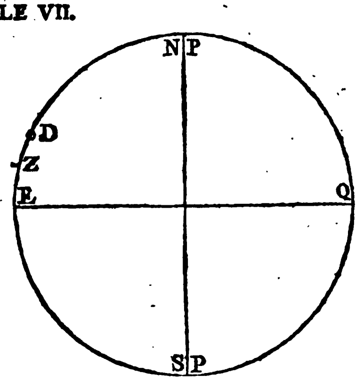
	° ′ ″	
Sun's true merid. alt.	64 20 0	
Zenith distance -	25 40 0	North.
Sun's declinat. north	14 20 0	
Latitude - -	11 20 0	South.



EXAMPLE VII.

Given, the true meridian altitude of the sun's center 82° 10′ north, and the declination 23° north. Required the latitude?

	° ′ ″	
Observed altitude	82 10 0	
	90 0 0	
Zenith distance -	7 50 0	North.
Declination -	23 0 0	North.
Latitude - -	15 10 0	North.



In the two last examples it is plain the observer is between the sun and the equator.

Suppose on the 12th of March 1806, by a back observation, the observed altitude of the sun is 25° 12′ south, the eye being 40 feet above

above the horizon, required the latitude in the longitude of 64° east and 64° west.

Sun's obs. alt.		25° 12'S.	Sun's obs. alt.		25° 12'S.
⊙ Semi-dia.	16	Sum + 22	⊙ Semi-dia.	16	Sun + 22
Dip	6		Dip	6	
App. alti.		25 34	App. alti.		25 34
Refraction		2	Refrac.		2
True alti.		25 32	True alti.		25 32
		90 00			90 00
True zenith dist.		64 28N.	True zenith dis.		64 28N
Dec. 12	3 28		Dec. 12	3 28	
Cor. for 64° E. long. From Table	+ 4	3 32 S	Cor. for 64W. long. By Table	− 4	3 24
Lat. in		68 00N	Lat. in		67 52N

As the declination in the tables is calculated for the meridian of Greenwich, it is plain that when a ship is to the eastward, and the declination decreasing, it must be more at the ship than at Greenwich; consequently the proportional parts of the daily difference must be added to the declination of that day; but when the ship is to the westward of London, the proportional parts must be subtracted, to find the true declination at the place of observation; but had the declination been increasing, the proportional parts must have been subtracted when to the eastward, and added when to the westward, to obtain the true declination at the ship; whence it follows, that no latitude can be truly ascertained without finding the sun's declination at the place of observation, as above, which is but too often neglected.

Here it may be observed also, that in a back observation, the sun being brought over the observer's head, the upper edge appears to him the lower one; and though the sun appears to the south of him, yet the zenith distance is north. The same may be observed if he is north of the sun. The back observation is seldom used, unless there is a high land, or other obstructions, between the observer and the sun.

The foregoing rules are for observing the sun, or a star, when they are at the greatest altitude, or upon the meridian above the pole; but as in some parts of the earth the sun does not set for several days, and some stars never set, in that case they may be observed when they are at the lowest, or upon the meridian below the pole. To work which observation, take the following

Rule.—Add the complement of declination to the true meridian altitude, the sum is the latitude, of the same name that the declination is of.

Suppose, on the 12th of June, 1806, an observer in a high northern

northern latitude, 65° weſt of Greenwich, his eye being 28 feet above the level of the ſea, ſhould obſerve the altitude of the ſun's lower limb on the meridian below the pole, to be 8° 15′ ſouth, by a fore obſervation. Required the latitude?

The ſun being obſerved below the pole, it muſt have been at 12 hours paſt noon, at the place of obſervation; and that place being 65° weſt of London = 4 hours 20′ later than at London, it muſt be 16 hours 20 minutes paſt noon at London.

Sun's declin. 12th June,	23° 8′ N.	
13th ditto,	23 12 N.	
Diff. -	0 4	
Correc. for 65° weſt of Greenwich, Tab. 18.	0° 0′ 53″	Add.
Decl. 12th June	23 8 0	Add.
Correct. declin.	23 8 53 North.	

Sun's obſerved alt.	8° 15′ 0″
From ſemi-dia. 16—5 dip, diff.	0 11 0 add.
Apparent altitude	8 26 0
Refraction ſubtr.	0 6 0
True merid. alt.	8 20 0
Compl. of S.'s dec.	66 51 7
	75 11 7 North.

At ſea I took the altitude of the north pole-ſtar, when on the meridian below the pole, and found it 46° 21′. Required the lat.?

Mer. alt. -	46° 21′ 0″
Compl. of decl.	1 43 50 North.
Latitude in	48 4 50 North.

The pole ſtar is the laſt in the tail of the Little Bear, and is known by two ſtars always pointing to it, commonly called the Pointers. How to find and know the ſtars, will be further elucidated when we come to treat of finding the longitude at ſea.

OF THE VARIATION OF THE COMPASS.

THE variation of the compaſs is an arch of the horizon contained between the meridian of the place and the magnetic meridian, and is either eaſt or weſt; or it is the number of degrees, &c. the needle's point ſtands from the true north or ſouth points of

of the horizon, reckoned to the eaftward or weftward, and is readily found from the fun's amplitude or azimuth.

To find the true Amplitude.

The fun's true amplitude is an arch of the horizon, comprehended between the true eaft or weft points thereof, and the center of the fun at its rifing or fetting; or it is the number of degrees, &c. the fun rifes or fets to the northward or fouthward of the eaft or weft point of the horizon.

The fun's magnetic amplitude is the number of degrees, &c. the center is northward or fouthward of the eaft or weft points of the compafs at his rifing or fetting, and is found with an azimuth compafs in the following manner:

Having placed the azimuth compafs in a convenient part of the fhip, look directly through the fight vanes at the fun's center; and when the fun's lower edge juft touches the horizon, ftop the card, by a ftop which is placed on the compafs for that purpofe; then the quantity of degrees and minutes contained between the eaft or weft, and the north or fouth, points of the compafs, will be the magnetic amplitude.

The true amplitude is found either by infpection in the Tables of the Sun's Amplitude, or by calculation, as follows:

RULE. As the fine compl. of the lat. or fec. lefs radius
Is to radius,
So is the fine of the fun or ftar's declination
To the fine of the true amplitude.

Which is always of the fame name with the declination, whether north or fouth.

EXAMPLE I.

Suppofe the fun's declination to be 10° 43′ S. in lat. 51° 32′ N. I demand the true amplitude?

As fine com. lat. 51° 32′	9.79383	Or thus:	
Is to radius	10.00000	Lat. 51° 32′ N. fecant	0.20617
So is fi. fun's dec. 10° 43′ S.	9.26940	Decl. 10 40 S. log. fine	9.26940
To fi. of true amp. 17° 24′	9.47557	True amp. 17° 24′ S. =	9.47557

EXAMPLE II.

In latitude 38° 25′ N. what is the fun's true amplitude when the declination is 18° 59′ N.?

As fine com. lat. 38° 25′	9.89405	Or thus:	
Is to radius	10.00000	Lat. 38° 25′ N. fecant	0.10595
So is fine declin. 18° 59′	9.51227	Decl. 18° 59′ N. log. fine	9.51227
To fun's true amp. 24° 32′	9.61822	Log. fi. 24° 32′ true am. N.	9.61822

To find the true Amplitude by the Table of Amplitudes.

Look for the given declination at the top of the table, and the latitude in the first column on the left hand, in the common angle of meeting, will be the degrees and minutes of the amplitude required.

EXAMPLE. I.

In latitude 40° N. when the declination was 17° N. required the sun's true amplitude at rising?

Under declination 17°, and right against the latitude 40° stand 22° 26′ the true amplitude, and is to be counted from the east towards the north, because it is at the sun's rising, and the declination is north; that is, E. 22° 26′ N.

But when the latitude is given in degrees, and the declination in degrees and minutes, find the declination at the top as before, and the nearest degrees to the given latitude in the left-hand column, against which, and under the given declination, stands the true amplitude; or, if the minutes of the declination be near 30, or half a degree, find the amplitude for the given degrees of declination, and the amplitude for one degree above it; add these two amplitudes together, half the sum will be the true amplitude, sufficiently exact for practice at sea.

EXAMPLE II.

Suppose I would know the sun's true amplitude at his setting, in latitude 57°, his declination being 11° 33′ S.

Find the ampli. as before for the Lat. 57, and the declination	11°	which will be	20° 30′
	12		22 26
		Their sum	42 56
		Half the sum	21 28

is the true amplitude: that is, W. 21° 28′ S. because at sun setting, and the declination south. In like manner, if the declination be in degrees, and the latitude in degrees and minutes, as in

EXAMPLE III.

Suppose it were required to find the sun's true amplitude at setting, in latitude 49° 27′, when his declination was 21° north.

Now 27 minutes being nearly half a degree, therefore,

I or lat.	49	and declination 21°	33° 7′
	50	the amplitudes are	33 53
		Sum	67 00

Half the sum is 33 30, the true amplitude required; that is, W. 33° 30′ N. because the sun was setting, and the declination N.

When the latitude and declination are both given in degrees and minutes, take the nearest degrees to both, unless they are near 30 minutes, as observed before, and find the amplitude as in Example I.

EXAMPLE

EXAMPLE IV.

Suppose it were required to find the sun's true amplitude at setting, in latitude 49° 20', his declination being 19° 40' N.

Now as the latitude is nearest to 49° and the declination nearest 20°, therefore against latitude 49° and under declination 20°, stands 31° 25' N. the true amplitude; that is, W. 31° 25' N. the declination being north, and at the sun's setting.

To find the true Azimuth.

The true azimuth is an arch of the horizon contained between the meridian of the place and the azimuth circle passing through the center of the sun or star at the time of observation; or it is the true distance of the sun or star from the true north or south points of the compass.

The magnetic azimuth is an arch of the horizon contained between the magnetic meridian and the azimuth circle passing through the center of the sun or star when observed; or it is the apparent distance of the sun or star from the north or south points of the compass, either in the forenoon, or in the afternoon, when they are 5°, 10°, 15°, &c. above the horizon, and the less the altitude is, the more exact you may perform the observation.

The magnetic azimuth is found by the compass, in the following manner:

Place the compass in a convenient part of the ship; then move it so that the sights may be directed to the sun's center; and the shadow of the string will fall directly on the line marked on the plain which joins the sights; then the degree, &c. in the arch intercepted between the end of the index, and north point of the card, will give the magnet azimuth required. If the sun does not shine strong enough to give a strong shadow, look through one of the sights, and move the compass till one of the strings cuts the sun's center, and then the intercepted arch, as before, shews the sun's azimuth, and the like of the star's.

When there is a rough sea, the observation is best made by two persons, and if the card vibrates much, take the middle degree between the limits which the vibration reaches.

When the azimuth is observed, the altitude of the object must be observed at the same time.

Having the latitude of the place of observation, and the sun or star's declination with the true altitude at the time of observation, the true azimuth is found as follows:

Rule. From the half sum of the complement of the latitude, the complement of the altitude and the sun or star's polar distance: subtract the polar distance, noting the half sum and the remainder. Then add together

The log. sine of the	Lat. co ar. = co sec.	less rad. or
complement of the	Alt. co ar = co sec.	indexes.

The

The log. ſine of the half ſum,

And the log. ſine of the remainder, into one ſum.

Half the ſum of theſe four logarithms will give the log. co-ſine of half the true azimuth, which being doubled, gives the true azimuth, reckoned from the north in north latitude, and from the ſouth in ſouth latitude.

N. B. The polar diſtance of the ſun or ſtar, is their diſtance from the neareſt, or elevated pole, and if the latitude of the place, and the declination of the ſun or ſtar, be both north, or both ſouth, then the complement of the declination is the polar diſtance; but if the latitude and declination be one north and the other ſouth, the declination added to 90° gives the polar diſtance.

EXAMPLE. I.

In latitude 51° 32′ N. the ſun's altitude was obſerved to be 39° 28′, his declination being then 16° 37′ N. required the true azimuth.

	90° 00′		90° 00′		90° 00′
Lat.	51 32	Alt.	39 28	Dec.	16 37
		Com. Alt.	50 32	Pol. diſt.	73 23

Co Lat.	38 28	Sine co ar =	Co Secant less rad.	0,20617
Co Alt.	50 32	Sine co ar =		0,11239
Pol. diſt.	73 23			
Sum	162 23			
½ Sum	81 11	Sine		9,99484
Pol. diſt.	73 23			
Rem.	7 48	Sine		9,13263
				2)19,44603
Log. co ſi of ½ the Azimuth		=	58° 06′	9,72301
			2	
True Azimuth	——		116 12 from the North.	

EXAMPLE II.

In latitude 42° 16′ N. the ſun's altitude was obſerved to be 18° 40′, his declination being then 7° 38′ S.; required the true azimuth?

	90° 00′		90° 00′		90° 00′
Latitude	42 16 N.	Altitude	18 40	Declination	7 38 S.
		Coalt	71 20	Polar diſt.	97 38

Co-lat,

Co-lat.	47	44	Co secant	0,13076
Co-lat.	71	20	Co secant	0,02347
Polar dist.	97	38		
Sum	216	42		
½-Sum	108	21	Log. sine	9,97733
Polar dist.	97	38		
Remainder	10	43	Log. sine	9,26940
			Sum	19,40096
½-Sum log. co-si.	59, 53		=	9,70048
	2			
True azimuth	119	46	from the north.	

The following questions are set down for the Learner's Exercise:

Quest. I. Being at sea, in latitude 40° 38′ N. in the afternoon, the sun's altitude was observed to be 20° 46′, when his declination was 17° 10′ S. what was the sun's azimuth at that time?

Ans. 137° 50′ from the north.

Quest. II. What is the sun's true azimuth in lat. 26° 30′ N. in the forenoon, when his altitude is 24° 28′, and his declination 22° 40′ N.?

Ans. 75° 44′ from the north point of the compass.

Quest. III. At the island of St. Helena, the sun's altitude was observed to be 30° 22′ in the forenoon, his declination being then 22° 58′ S. required the azimuth at that time?

Ans. 72° 22′ from the south, or 107° 38′ from the north.

Quest. IV. What is the bearing of the star Aldebaran at the Cape of Good Hope, when its altitude is 22° 25′?

Ans. 130° 20′ from the south, or 49° 40′ from the north.

Having found the sun's true amplitude or azimuth by the preceding methods, &c. magnetic amplitude or azimuth by observation, it is evident, that when they agree there is no variation; but when they disagree, then, if the true and observed amplitudes be both of the same name, that is, both north or both south, their difference is the variation; but if the true and observed amplitudes be of different names, that is, one north and the other south, their sum is the variation. Again, if the true and observed azimuths be both on the east, or both on the west side of the meridian, their difference is the variation; but if the true and observed azimuths be one on the east and one on the west side of the meridian, their sum gives the variation; and to know whether the variation is easterly or westerly, observe this general RULE,

RULE.

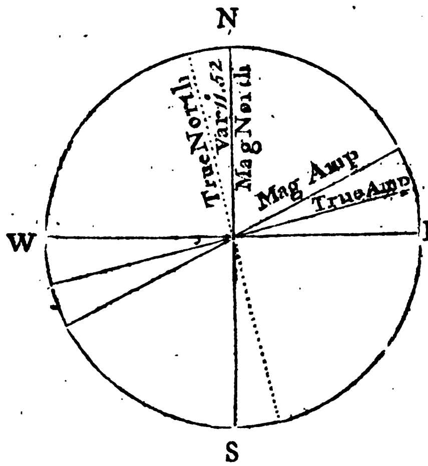
Let the obferver's face be turned to the fun; then, if the true amplitude or azimuth be to the right hand of the magnetic, or obferved, the variation is eafterly; but if to the left hand, wefterly.

EXAMPLE I.

Suppofe the fun's magnetic amplitude at rifing is found to be E. 26° 12′ N. but the true is found to be E. 14° 20′ N.; required the variation?

From the greater	E. 26° 12′ N.
Take the leffer	E. 14 20 N.
Remains the variation	11 52 E.

Which is eafterly, becaufe in this cafe the true amplitude is to the right of the obferved.



With the chord of 60 defcribe a circle to reprefent the compafs, through which draw the north, fouth, eaft, and weft lines; take the amplitude at rifing, 26° 12′ from the line of chords, and fetting it from E. towards N. and likewife the true amplitude 14° 20′, and fet it from E. towards N. as before, the difference of thefe two angles, or between the true and magnetic amplitude, viz. 11° 52′ is the variation. Now fuppofe yourfelf placed at the centre of the horizon reprefented by the compafs, and looking towards the magnetic amplitude at the fun's rifing, it is plain that the true amplitude found by calculation is towards the right hand of the obferved, which fhews the variation is 11° 52′ E. and muft be allowed to the right hand in all courfes fteered, before they can be put in the Traverfe Table or bearings, taken by the compafs.

EXAMPLE II.

Suppofe the fun's true amplitude at fetting be W. 34° 26′ S. and his magnetic amplitude W. 23° 13′ S. required the variation, fince they are both of the fame name?

From

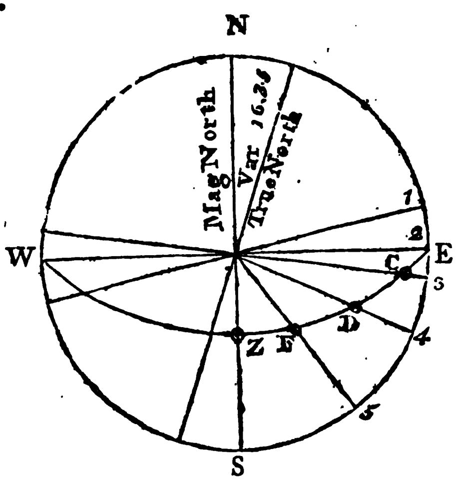
From the true	—	W. 34° 26′ S.
Take the magnetic	—	W. 23 13 S.
Remains the variation	.	11 13 W.

Which is westerly, because the true amplitude is to the left of the observed in this case.

EXAMPLE III.

Suppose the true azimuth — 84° 40′ W.
The mag. az. 101 15 W.

* Variation 16 35



* Let N. E. S. and W. represent the horizon; C, D, F, an azimuth circle, passing through the sun's centre; now an observer, placed at the centre, will see the sun at rising, in the line 1, but when he gets a greater altitude, and arrives at E, he will see the sun in the line ⊙ 2, and as the sun alters its altitude, will be seen in the line ⊙ 3, ⊙ 4, ⊙ 5, at length will arrive at its meridian, Z, S, and the figures, 2, 3, 4, 5. will represent the different magnetic azimuth; the difference between any of these and the true azimuth found by calculation, is the variation.

EXAMPLE IV.

Suppose the sun's true amplitude at rising is E. 13° 24′ N. and his magnetic amplitude E. 12° 32′ S. required the variation, and which way?

Since the true amplitude and observed have different names,

To the true amplitude	E. 13° 24′ N.
Add the magnetic amp.	E. 12 32 S.
Their sum is the variation	25 56 W.

Which is westerly, because the true amplitude is to the left of the observed.

EXAMPLE V.

Suppose the sun's true azimuth in the forenoon is N. 86° 40′ easterly, but by the compass it is N. 73° 24′ easterly; required the variation, and which way?

Since the true and observed azimuths are both on the same side of the meridian,

From the greater	N. 86° 40′ E.
Take the lesser	N. 73 24 E.
Remainder variation	13 16 E.

Which is easterly, because the true azimuth is to the right of the observed.

EXAMPLE

EXAMPLE VI.

Suppose the sun's true azimuth is N. 32° 28′ easterly, and his magnetic azimuth N. 8° 50′ west; required the variation, and which way?

Since they are on the different sides of the meridian,

To the true azimuth,	N. 32° 28′	E.
Add to the mag. azim.	N. 8 50	W.
Sum is the variation	41 18	E.

Which is easterly, because the true azimuth is to the right of the observed.

EXAMPLE VII.

Suppose the sun's true azimuth S. 17° 45′ E. and the magnetic azimuth S. 5° 48′ W. required the variation, and which way?

Since they are on different sides the meridian,

To the true azimuth,	S. 17° 45′	E.
Add the observed az.	S. 5 48	W.
Sum is the variation	23 33	W

Which is west, because the true azimuth is to the left of the observed.

The use of the variation is to correct the course steered by the compass; when the variation is east, it must be allowed to the right hand upon every course steered quite round the compass; but when the variation is west, to the left hand.

NOTE. The variation may be easily found by taking the sun's altitude in the morning, and observing what point of the compass he bears upon; and in the afternoon when the altitude is the same, the middle point will be the true meridian, the difference between which and the north or south points of the compass is the variation. If the altitudes are taken at 5, 6, or 7 o'clock in the morning, you will have the same altitude at 5, 6, or 7 o'clock in the evening, being equally distant from noon.

The variation of the compass was first observed at London, in the year 1580, to be 11° 15′ easterly; and in the year 1622, it was 6° 0′ E. still decreasing, and the needle approaching the true meridian, until it coincided with it in the year 1662, since that time the variation still continues at London to increase westerly, at the rate of about 11 or 12 minutes every year; and is at this time about 23° 30′ westerly, and in the English channel about 28° 00′ westerly; but how far it will go that way, time and observations will probably be the only means to discover.

The variation at Paris in the year 1640, was 3° E. but in the year 1681 it was 2° 21′ W. and is now about 22° 20′ westerly, still continuing to go westerly.

In short, from observations made in different parts of the world, it appears, that in different places the variation differs, both as to its quantity and denomination, it being east in one place, and west in another; the true cause and theory of which has not yet been discovered, and therefore in long voyages it is absolutely necessary that the mariner should find the variation of the compass by observation as often as possible.

THE

THE METHOD OF KEEPING A SHIP's RECKONING OR JOURNAL AT SEA.

BY keeping a Ship's Reckoning, or Journal, is meant keeping an account of the ſhip's way, that the mariner may be able at any time to aſcertain the latitude and longitude the ſhip is in; it therefore ſhould be the great concern of every perſon who takes upon them the navigating of ſhips to remote parts, to be expert therein, as the lives and fortunes of ſo many men are committed to their charge.

When a ſhip is bound from one place to another, which lies ſo far from her that ſhe is obliged to go out of ſight of land for any conſiderable time, as from England to Jamaica; at the time of her leaving ſight of land, ſhe is ſaid to take her departure, and that part of the land ſhe then leaves is ſaid to be the place ſhe takes her departure from; ſuch as the Land's-end, Lizard, &c. and at the time of taking ſuch departure, the captain or mate generally takes the bearing or diſtance of that land, (according to his judgment,) and ſets it down on the log-board, or in the log-book, againſt the time it was taken, thus, Land's-end, N. N. E. diſt. 7 leagues, or Lizard N. by W. diſt. 5 leagues, &c.

In the ſame manner may the departure from any place be taken, as may be ſeen in the firſt day's log of the following journal, where the log-book is marked in columns for hours, knots, fathoms, courſes, winds, lee-way, tranſactions; and under it the columns for courſes, diſtances, northings, or ſouthings, eaſtings, or weſtings, the latitude by dead reckoning, latitude by obſervation, meridian diſtance, difference of longitude, longitude in, and in the laſt, bearing and diſtance of the land.

Notice muſt be taken, that in the column for courſe, you are always to ſet down the courſe you have made by your reckoning for that twenty-four hours; that is, from the noon of the day before to the noon of the day you work on, the ſea account being always kept from noon to noon.

Dead reckoning is that account deduced from occurrences which are written on the log-board.

In the columns for diſtance you are to ſet down the diſtance made by your reckoning for that twenty-four hours.

In the columns of northing and ſouthing, you are to ſet down the difference of latitude made in that twenty-four hours, marking the column with north, if the difference of latitude be north; and ſouth, if ſouth.

In the column of eaſting or weſting, you are to ſet down the departure made that twenty-four hours, marking the column with eaſt, if the departure be eaſt, and with weſt, if weſterly.

In the column marked latitude by D. R. you are to ſet down the latitude you reckon yourſelf in on that day; and in the column marked lat. by ob. you are to ſet down the latitude found by obſer-

vation; alſo the difference of longitude made in the 24 hours in the column marked diff. long.; the longitude in, in the column marked long. in; and in the laſt, the bearing and diſtance from the land.

The variation, if any, muſt be allowed upon all courſes ſteered, and upon all bearings that are taken by the compaſs; that is, if it be eaſterly variation, it muſt be allowed to the right hand; if weſterly, to the left of the courſe or bearing. Suppoſing yourſelf placed in the centre of the compaſs, and looking directly forward to the point you are to allow the variation upon.

EXAMPLE.

Suppoſe I ſteer S. W. and there is one point weſterly variation, then my true courſe is S. W. by S.; or ſuppoſe I ſet a point of land, and find it to bear by the compaſs E. S. E. and I know there is half a point eaſterly variation, then the true bearing is S. E. by E. ½ E.

Leeway muſt be allowed upon all courſes ſteered, which is the difference between the point which the ſhip endeavours to ſail upon, and the point ſhe really ſails upon, and is cauſed by the force of the wind or ſurge of the ſea, when ſhe is cloſe hauled or plying to windward, which makes her fall off and glide ſideways from the point of the compaſs ſhe capes at, and muſt be allowed on the right hand of the courſe ſteered when the larboard tacks are on board, and to the left hand when the ſtarboard tacks are on board. The allowances that are generally made are as follow:

1ſt. When a ſhip is cloſe hauled, if all her ſails be ſet, the water ſmooth, and a moderate gale of wind, ſhe is then ſuppoſed to make little or no leeway.

2dly. The ſhip being upon a wind, and the ſmall ſails in, allow one point for leeway.

3dly. The wind blowing hard, ſo as to cauſe one top-ſail to be taken in, allow two points for leeway.

4thly. When it blows ſo hard that both top-ſails are taken in, and the ſea runs high, allow then three points for leeway.

5thly. The fore-ſail being furled, and the ſhip tries under a main-ſail and mizen, allow four points for leeway; for ſhe then makes her way about four points before the beam, as the ſea phraſe is.

6thly. When the ſhip tries under the main-ſail only, ſhe then makes her way about three points before the beam, that is, allow near five points leeway.

7thly, If the ſhip tries under the mizen only, the way is about two points before the beam, that is, allow ſix points for her leeway.

8thly. When ſhe lies hull, that is, with all her ſails furled, her way is one point before the beam, and then ſeven points is her leeway.

9thly. When a ſhip is lying to under a main-ſail, mizen, &c. then obſerve how ſhe comes up and falls off, and take the middle between the two points, and from that allow the leeway and variation.

Note

NOTE. In all cafes refpect muft be had to the fmoothnefs of the water, or to the fea's running high, and the mould and trim of the fhip, and then the allowances may be afcertained with the greater certainty, by fetting the fhip's wake by a compafs placed on each rail of the fhip's quarter, which is ufually fet there for that purpofe.

For it is well known that fome fhips, with the fame quantity of fail, and with the fame gale, will make more or lefs leeway than others; and alfo the fame fhip, when fhe is out of her trim, or differently loaded, will make different leeways: for it is obfervable, that the more water a fhip draws, the lefs leeway fhe makes; becaufe fhe then meets with a greater refiftance in fplitting the water with her fide, than otherwife fhe would

The leeway may be eafily found by the azimuth compafs, by turning the inftrument about until you fee the wake of the fhip either over the fights or parallel to them; then the point of the card, which is cut by the vertical line in the box, which is neareft to you, is the true courfe; the difference between that and the courfe given by the compafs in the binnacle, is the leeway required, which ought to be accordingly entered upon the log-board.

There is another way of finding the leeway, by fixing a compafs cut in lead (or other metal) on the poop, or fome other convenient part of the fhip's ftern, with the meridian parallel to the fhip's keel.

By fome of the above methods, the leeway (if there be any) ought to be carefully obferved as often as may be judged neceffary; and thefe obfervations fhould be punctually fet down by the officer of the refpective watch; at leaft, if no obfervation be made, he ought to fet down the leeway according to his judgment once or twice in the watch, and by this means the courfe made good may be found to a much greater certainty and exactnefs than by the common method of allowing for leeway, when the day's account comes to be worked (which is generally once in 24 hours); for an obfervation muft certainly be better than any guefs. But if no obfervation be made, the perfon who is upon deck, and has the care of the watch, is better able to make proper allowances, while things are frefh in his memory, and while he is an eye-witnefs of the feveral occurrences that happen; and certainly much more capable than another who was not upon the deck during the whole watch.

I have often admired to fee how particularly every thing is ftated upon the log-board, excepting the leeway: and yet that (which is one of the moft material articles, fince the courfe, according to the compafs, muft be corrected by it) only allowed for the next day, according to every one's fancy, thereby, as it were, keeping as many different journals as there are artifts (fo called) on board the fhip, and yet not one regular journal properly kept amongft them all, fince one of the moft material articles is only gueffed at.

EXAMPLE I.

Suppose I steer N. E. by E. with my Larboard Tacks on Board, and make one Point Leeway, then my Course made good is E. N. E.

Leeway and Variation, when they are both to be allowed one Way, that is, both to the right Hand, or both to the left, add them together, and allow their Sum the same way they were to be allowed.

But if they are to be allowed, one to the Right Hand and the other to the Left, subtract the less from the greater, and allow the Remainder the same Way the greater was to be allowed.

EXAMPLE II.

Suppose I steer N. N. W. with my Starboard Tacks on Board, and make one Point Leeway, there being at the Time Half a Point Westerly Variation; I would know my true Course?

Leeway to the Left Hand	1 Point.
Variation to ditto	½ Point.
Their Sum to be allowed to the Left Hand	1½ Point

Whence the true Course is N. W. by N. ½ W.

EXAMPLE III.

Suppose I steer S. W. by W. with my Larboard Tacks on Board, and make two Points and a Half Leeway, and I have one Point and a Quarter Westerly Variation, what is my true Course?

Leeway to the Right Hand	2½ Points.
Variation to the Left Hand	1¼ Point W.
The Remainder to be allowed to the Right Hand	1¼

Whence the true Course W. S. W. ¼ Westerly.

EXAMPLE IV.

Suppose a Ship lying to under a Main-sail, with her Starboard Tacks on Board, comes up E. by S. and falls off to N. E. by E. there being one Point Westerly Variation, and she makes 5 Points Leeway, what Course does she make good.

The Middle between E. by S. and N. E. by E. is E. by N. for which allowing 6 Points to the Left Hand, the true Course will be N. by E.

It is plain by the preceding Examples. that if the Leeway is made towards the Meridian, it is taken from the Course steered; but when it is made from the Meridian, it must add to the Course steered, to find the true Course. The same may be observed of the Sum or Difference of the Leeway and Variation, as may be seen by the following Table, which is here set down to exercise the young Navigator in the foregoing Rules.

THE

THE TABLE.

Courſes ſteered.	Winds.	Lee-way.	Variation.	Courſes corrected.
N. W. $\frac{1}{2}$ W.	N. N. E.	$\frac{1}{2}$	$\frac{3}{4}$ W.	N. $5\frac{3}{4}$ W.
W.	N. N. W.	$\frac{3}{4}$	$\frac{3}{4}$	S. $6\frac{1}{2}$ W.
W. S. W.	S.	1	$\frac{3}{4}$	S. $6\frac{1}{4}$ W.
W.	S. S. W.	$\frac{3}{4}$	$\frac{3}{4}$	W.
W. by N.	N by W.	$1\frac{1}{4}$	$\frac{3}{4}$	S. 7 W.
S. W.	W. N. W.	$1\frac{1}{2}$	$\frac{3}{4}$	S. $1\frac{3}{4}$ W.
S.	W. S. W.	$\frac{3}{4}$	$1\frac{1}{4}$	S. S. E.
S. S. W.	W.	1	$1\frac{1}{4}$	S $\frac{1}{4}$ E.
S. W.	N. W. by W.	$\frac{1}{2}$	$1\frac{1}{4}$	S. S. W. $\frac{1}{4}$ W.
W.	S. S. W.	$1\frac{3}{4}$	$1\frac{1}{4}$	W. by N. $\frac{1}{2}$ W.
W by N.	N. by W.	1	$1\frac{1}{4}$	W. S. W. $\frac{3}{4}$ W.
S.	E. S. E.	2	$1\frac{1}{4}$	S $\frac{3}{4}$ W.
E. by S.	S. $\frac{1}{2}$ E.	$\frac{3}{4}$	$1\frac{1}{4}$	E. by N.
E. N. E.	N.	$1\frac{3}{4}$	$1\frac{1}{4}$	E. N. E. $\frac{1}{2}$ E.
E.	N.	$\frac{3}{4}$	$1\frac{1}{4}$	E. by N. $\frac{1}{2}$ E.
E.	S.	0	$1\frac{1}{4}$	E. N. E. $\frac{3}{4}$ E.
S.	E. S. E	$\frac{1}{2}$	$1\frac{3}{4}$	S. by E. $\frac{1}{4}$ E.
E. S. E.	N. E.	$\frac{1}{2}$	$1\frac{3}{4}$	E by S. $\frac{1}{4}$ E.
W. S. W.	S.	$\frac{3}{4}$	$1\frac{3}{4}$	S. W. by W.
W. by N.	S. W. by S.	1	$1\frac{3}{4}$	W. $\frac{1}{4}$ N.
N. W.	W. S. W.	1	$1\frac{3}{4}$	N. W. $\frac{3}{4}$ W.
S.	W. S. W.	1	$0\frac{3}{4}$ E.	S. $\frac{1}{4}$ E.
N. by E.	N. W. by W.	$\frac{3}{4}$	1	N. N. E. $\frac{3}{4}$ E.
N. W. by N.	W. by S.	$1\frac{1}{4}$	1	N. $\frac{3}{4}$ W.
N. W. by W.	N. by E.	$1\frac{1}{2}$	$1\frac{1}{4}$	N.W. by W $\frac{1}{4}$ W.
W by S.	N. W. by N.	$1\frac{3}{4}$	$2\frac{1}{4}$	W. $\frac{1}{2}$. S.

Note, In ſailing in the Channel, or along a Coaſt in a Stream Tide or Current, particular Care muſt be taken to take its ſetting for a Courſe, and its drift for a Diſtance, if poſſible, which muſt be entered among the Courſes and Diſtances in the Table of that Day's Reckoning. And where the ſetting of the Stream-Tide and Drift are not known, you muſt attain the Point it muſt ſet upon, from the Chart of the Coaſt you are ſailing along, by the times the Stream ends at different Places on the Coaſt, and by the Principles of Fluids againſt ſuch Rocks, Shoals, Sand-Banks, &c. By a ſtrict regard to theſe, both the drift and ſetting of the Stream-Tides may be pretty nearly aſcertained and allowed for.

Currents, the Way they ſet you, and the Diſtance you ſuppoſe you are driven by them, is to be ſet in the Traverſe Table for the Day, as any other Courſe and Diſtance.

EXAMPLE V.

Suppoſe I try the Current, and find it to ſet W. by N. per Compaſs one Mile per Hour, the Variation being one Point Eaſterly; then if I ſail in that Current 24 Hours, I ſet down in the Traverſe Table, as a Courſe, W. N. W. Diſtance 24 Miles.

Heave

Heave of the Sea is to be accounted for in the ſame Manner as Currents: As, ſuppoſe there is a great ſea heaving towards the S. W. by my Compaſs, there being Half a Point Weſterly Variation, I then ſet down in my Traverſe Table S. W. by S. half Weſterly, with ſo much Diſtance as I judge the Sea has heaved the Ship.

At leaving the Land, the oppoſite Point of the Bearing, with the Variation allowed upon it, and the Diſtance you judge yourſelf from it, muſt be ſet down in the Traverſe Table as a Courſe and Diſtance.

EXAMPLE VI.

Suppoſe, having Two Points and a Half Weſterly Variation, the Start bearing by my Compaſs N. E. diſt. 4 Leagues; the oppoſite Point to N. E. is S. W. which, with the Variation, makes S. by W. $\frac{1}{2}$ W. for the Cou. to be ſet in the Traverſe Table diſt. 12 Miles.

When you make the Land the Bearing, itſelf (with the Variation allowed upon it) and the Diſt. you judge yourſelf from it) is to be ſet down in the Traverſe Table as a Cou. and Diſt. This needs no Example.

The Courſes marked on the Log-board are the Courſes ſteered by the Compaſs. In order to obtain the true Courſe, it is neceſſary to allow both for the Variation of the Compaſs, and for the Leeway, upon each Courſe on the Log-board, as has been ſhewn, before they are put into the Traverſe Table.

Every Day at Noon the Log-board is to be tranſcribed into the Log-book, which is ruled exactly like the Log-board.

Mariners keep the Reckoning for the Ship's Place. From Noon to Midnight they mark with P. M. ſignifying after Mid-day; and the ſecond twelve Hours with A. M. ſignifying after Midnight; ending their Day's Work at the Noon of the civil Day. Hence, their Ship's Account is twelve Hours earlier than their Shore Account of Time. And, as the Sun's Declination uſed for determining the Latitude at the End of the Sea day is calculated for the Noon of the Common-day at Greenwich, therefore the Declination for the Noon of the civil Day, muſt be taken for determining the Latitude, &c. at finiſhing their Day's Account. Thus, a Day's Work marked Tueſday, May 6th, began on Monday at Noon, and ends on Tueſday Noon, ſo that the Sun's Declination for the 6th of May is uſed for Tueſday, and fitted to the Meridian of the Ship, according as ſhe is E. or W. of Greenwich.

There are various Methods of keeping a Sea Journal, according to the Sentiments of various Perſons with regard to what deſerves being recorded: ſome approve of a Journal including the Log-book, each day's work at ſome length, and ſuch occurrences as ſeem of moſt importance; while others prefer a ſhort Abſtract of this long Journal, containing little more than the Courſe run, the Latitude and Longitude in, and ſometimes the Bearing and Diſtance of the intended Port, for each Day.

In the following Journal the long Form is uſed, as repreſenting more fully each day's work, and the neceſſary Corrections; and an Abſtract of this may be drawn out in the ſhorteſt Form that ſeems conſiſtent with Diſtinctneſs. The Learner ought to be thoroughly acquainted with the long Form, and when he does that, he may either continue it, or take the ſhorteſt Form; or retrenching from the firſt, and adding to the ſecond what Particulars he thinks proper, and may thereby make out a Form adapted to his own particular Taſte.

RULES

RULES for correcting the DEAD RECKONING by an Obfervation.

NOTWITHSTANDING the Rules already laid down for keeping a Ship's Way at Sea, yet by reafon of the feveral accidents that may attend a Ship in one Day's Run, fuch as fwelling Seas, different Rates of failing between the Times of heaving the Log, want of Care at the Helm in letting the Ship fall off, or come to accidental Currents, fudden fqualls, when no Account can be kept, &c. the Latitude by Account and Latitude by Obfervation may very often differ, then it is neceffary that proper Corrections be made in the Difference of Longitude.

When you have made all proper allowances you can, fuch as for Leeway, Variation, Currents, &c. and ftill find that your latitude by Account will not agree with your Latitude by Obfervation, then you muft correct as follows:

Firft, confider whether you have made proper Allowances for Currents, Heave of the Sea, if the Courfe of the Helm has been carefully attended to, if the Log-line and Half-minute Glafs be juft, and the Log properly hove, or any fudden fqualls, or proper Allowances made for the Leeway, &c. which of thefe you conjecture your error is in; make what Allowances you think meet to your Difference of Latitude and Departure by Dead Reckoning, and fee if that will reform your Latitude by Account, fo as to make it agree with your Latitude by Obfervation; if it does, you have gueffed right; (for you muft always keep to the Latitude by Obfervation, it being the only thing to be depended on;) but if it will not agree with the obferved Latitude, it is to be fuppofed that there are Miftakes in your Conjecture, or fome other Caufe, which produces the Error in the Reckoning, and ftands in need of being corrected. In this Cafe, you are firft to examine your Log-line and Half-minute Glafs, and if there be an Error in them, allow for it, as in the following Examples:

EXAMPLE. I.

Yefterday at noon, we were in latitude 48° 20′ N. and till this day at noon we have failed S. S. W. 48 miles, S. W. by S. 36 miles, N. E. 24 miles, and find by good obfervation that we are in latitude 47° 14′.

TRAVERSE TABLE.

COURSES.	DIST.	N.	S.	E.	W.
S. S. W	48		44,3		18,4
S. W. by S.	36		29,9		20,0
N. E.	24	17,0		17,0	
		17,0	74,2		38,4
			17,0		17,0
			57,2		21,4

By

By the Traverſe Table it appears, that by account the diff. of lat. is 57 ,2 S. and the departure 21,4 W.

Now the lat. left was	—	48° 20′ N.	Lat. left	48° 20′	N.
The diff. of lat. by account	—	0 57 S.	Lat. obſ.	47 14	N.
			Diff. Lat.	1 6=66	
Lat. in by account	—	47 23 N.			

Differing 9 miles from the true latitude by obſervation.

Wherefore I examine the log-line and half-minute glaſs, and find that the former meaſures 52 feet between knot and knot, and that the latter runs only 27 ſeconds. Now, as the log-line and half-minute glaſs are both faulty, I correct my difference of latitude and departure, as in Caſe III. and find my correct difference of latitude 66,2 S. and my departure 24,7 W.

Now from latitude left	——	48° 20′ N.
Take diff. lat. corrected for error in diſt.		1 6 S.
Lat. in, corrected for error in diſt.		47 14

Agreeing exactly with my latitude by obſervation: I therefore conclude my reckoning ſufficiently correct. Then, with the difference of latitude 66,2, and departure 24,7, together with yeſterday's latitude, I find the difference of longitude either by Middle Latitude, or Mercator's Sailing.

In the laſt Example 57,2 and 21,4, multiplied ſeverally by 156, thrice the meaſured length of a knot, and divide the two products by 135, five times the meaſured time of the glaſs, will give the difference of latitude 66,1, and departure, 24,7, which is the ſame thing as if every courſe had been corrected ſeparately.

EXAMPLE II.

Yeſterday at noon we were in lat. 36° 15′ N. and have ſailed theſe 24 hours S. E. ½ E. 55 miles, N. E. by N. 20 miles, W. S. W. 70 miles, S. by W. ½ W. 20 miles, and by obſervation this day at noon we were in lat. 34° 56′ N.

The TRAVERSE TABLE.

Courſes.	Diſt.	N.	S.	E.	W.
S. E. ½ E.	55		34,9	42,5	
N. E. by N.	20	16,6		11,1	
W. S. W.	70		26,8		64,7
S. by W. ½ W.	20		19,1		5,8
		16,6	80,8	53,6	70,5
			16,6		53,6
		Diff. Lat.	64.2	Dep.	16,9

By the Traverſe Table it appears, that by Account the Diff. of Lat. is 64.2 S. and the Departure 16.9 W.

Latitude

Latitude failed from	—	36° 15′ N.		36° 15′ N.
Difference of latitude by account		1 4 S.	Lat. obf.	34 56
Latitude in by account	—	35 11 N.	Diff. lat.	1 19

Differing 15 miles from the latitude by obfervation.

I now examine the log-line and half-minute-glafs, and find them both right. Next I confider whether there be any current, and I think I have reafon to fufpect one; upon trial I find there is one fetting S. S. W. $\frac{3}{4}$ W. at the rate of 7 fathoms an hour, and judge I have been in it thefe 24 hours. Then 7 fathoms (or tenths of a knot) per hour, in 24 hours, makes about 17 miles: and to the dift. 17 miles, and courfe S. S. W. $\frac{3}{4}$ W. the diff. of lat. is 14,6 S. and departure 8,7 W.

	Diff. lat.	Dep.		
Now by tra. table	64,2 S.	16,9 W.	Latitude failed from	36° 15′ N.
And by current	14,6 S.	8,7 W.	Diff. of lat. cor. for cur.	1 19 S.
Correct for cur.	78,8 S.	25,6 W.	Lat. in, correct for cur.	34 56 N.

Which agreeing with my latitude by obfervation, I conclude that my reckoning is right; then having the latitude left, and latitude come to, the difference of longitude may be found either by Middle Latitude or Mercator's Sailing, as before.

If, after all proper allowances are made for errors in diftance, currents, &c. the latitude by account and obferved latitude fhould difagree, then the reckoning muft yet be further corrected; and to do which, the following are the common, and feem to be the moft rational, methods:—

CASE I.

If the Courfe found by Dead Reckoning be lefs than three Points, or thirty-three Degrees.

RULE. To the difference of latitude and departure by account find a courfe; with this courfe and the difference of latitude by obfervation, find the difference of longitude, either by Middle Latitude, or Mercator's Sailing.

EXAMPLE.

Yefterday at noon we were in lat. 39° 18′ N. by an obfervation, this noon we are in lat. 37° 48′ N. and our dead reckoning gives 107 miles of fouthing, and 64 of wefting; required the true difference of longitude?

To the difference of latitude 107, and departure 64, I find the courfe 2 $\frac{\ }{4}$ points; then with the meridional difference of latitude between the two obfervations 115, and the fame courfe, I find the true difference of longitude 69 miles.

CASE II.

If the Course found by Dead Reckoning be more than three Points, or thirty-three Degrees, and less than five Points, or fifty-six Degrees.

Rule. With the diff. of lat. and dep. by account, find the distance; with this distance, and diff. of lat. by observation, find another departure. Take half the sum of this dep. and dep. by account, for the true dep. with which, and the diff. of lat. by observation, find the diff. of longitude.

EXAMPLE.

Yesterday at noon we were in lat. 52° 40′ N. and are this noon in lat. 54° 22′ N. having by account made 84 miles of northing, and 76 miles of westing; required the true difference of longitude?

To the diff. of lat. 84, and dep. 76, the distance is 113 miles, and the course 42°.

To dist. 113, and diff. of lat. between the two observations 102, the dep. is 49,5; then 76 added to 49,5 is 125,5, half of which is 62,7, the true dep.

To dep. 62,7, and diff. of lat. by observation 102, the course is 31°, and with the course 31° and the meridional diff. of lat. between the two observations 171, I find the diff. of long. is 103 miles.

CASE III.

If the Course by Dead Reckoning be more than five Points, or fifty-six Degrees.

Rule. With the diff. of lat. and departure by account find the distance; then with this dist. and diff. of lat. by observation find the diff. of long.

EXAMPLE.

Yesterday at noon we were in lat. 38° 52′ N. to-day at noon we are in lat. 40° 18′ N. and by account have made 68 miles northing, and 112 miles of westing; required the true diff. of longitude?

With the diff. of latitude 68, and departure 112, I find the distance 131 miles, and to distance 131, and difference of latitude by observation 86, the course is 49°, nearly; with this course, and the meridional difference of latitude between the two observations 111, the difference of longitude is 128 miles.

The reason of the above rule is plain, if we consider, that when a ship sails near the meridian, it will require a sensible error in the course, to make any considerable error in the difference of latitude; which can hardly happen if proper care is taken at the helm; and therefore it is most likely that the error is in the distance run; but when the course is near the middle of the quadrant, or between 3 and 5 points from the meridian, it is then probable the error may be in

in both courſe and diſtance; and when the courſe is more than five points from the meridian, it is then moſt likely the error is in the courſe, as it will require a great error in the diſtance to make any conſiderable one in the difference of latitude.

Note. As the true place of a ſhip depends upon her latitude and longitude being truly aſcertained, I have ſet theſe down only, the reſt being of leſs conſequence to the mariner.

To correct for ſeveral Days.

By help of the three preceding rules, the longitude may always be corrected for a ſingle day, but if an obſervation has been wanted for one or more days, then mark the latitude and longitude at laſt obſervation, or if this be your firſt obſervation ſince leaving the land, mark the latitude and longitude of the land you left; this is the only latitude and longitude you can call certain; all the following part of the reckoning muſt undergo a correction, which is made as follows:

Take the northings, ſouthings, eaſtings, and weſtings, that you have made ſince your laſt obſervation; or, if this be your firſt obſervation, then for every day from your leaving the land, minding not to leave out the difference of latitude and departure of the day you correct on, and bring them into the Traverſe Table, by which you will have the whole difference of latitude and departure by account ſince the laſt obſervation; and with that ſame difference of latitude and departure find the courſe by dead reckoning; then obſerve which of the foregoing caſes that courſe falls under, and correct by the rule for that caſe. But when an obſervation has been wanting for ſeveral days, then mark the latitude and longitude you were in at your laſt obſervation, or on leaving the land as before, and then you may correct with a greater degree of certainty, eſpecially in high latitudes, by the following rules:

CASE I.

Reckoning from the laſt certain latitude and longitude.

When the courſe given by the meridional difference of latitude and difference of longitude by account, taken as difference of latitude and departure, is leſs than three points, or 33 degrees.

Rule. To the meridian difference of latitude and difference of longitude by account (taken as difference of latitude and departure, as ſhewn in Mercator's Sailing), find a courſe; with this courſe, and the meridian difference of latitude by obſervation, find a correſponding departure, which will be the correct difference of longitude.

EXAMPLE I.

Having ſailed three days ago from latitude 49° 57′ N. and got no obſervation till this day at noon, and find I am in latitude 45° 23′ N. and by dead reckoning I am in 45° 12′ N. having differed my longitude 173 miles; required my difference of longitude?

	M. Parts.			M. Parts.
Lat. failed from	49° 57′ N. 3470	Lat. failed from	49° 57′	3470
Lat. by account	45 12 N. 3047	Lat. by obfer.	45 23	3063
	4 45		4 34	
Merid. diff. of lat. by acc.	423	Mer. diff. of lat. by obf.		407

To meridian difference of latitude by account 423, and difference of longitude by account 173, the courfe is 22° 15′. Then with the courfe 22° 15, and meridional difference of latitude between the obfervations 407, I find the difference of longitude is 167 miles.

CASE II.

When the courfe given by the meridional difference of latitude and difference of longitude by account (taken as before) is greater than three points, and lefs than five points,

RULE. To the meridian difference of latitude and difference of longitude by account, taken as difference of latitude and departure, find a diftance; with this diftance, and meridian difference of latitude by obfervation, find a correfponding departure; half the fum of this departure, and the difference of longitude by account, is the correct difference of the longitude.

EXAMPLE II.

Three days ago we were in latitude 45° 23′ N. and have fince that time failed between fouth and weft, have, by dead reckoning altered our latitude 94 miles, and our longitude 147 miles; but by an obfervation this day, we find we are in latitude 43° 34′; required the correct difference of longitude?

	M. Parts.		M. Parts.
Lat. failed from 45° 23′ N.	3063	Lat. failed from 45° 23′ N.	3063
Lat. by acc. 43 49 N.	2931	Lat. by obfer. 43 34 N.	2910
1 34		1 49	
Mer. diff. of lat. by account.	132	Mer. diff. by obfervation.	153

With the meridian difference of latitude by acc. 132, and difference of longitude by acc. 147, I find the diftance 198, and courfe 48°. Then with the diftance 198, and meridian difference of latitude by obfervation 153, the dep. is 125; now 125 added to 147 is 272, and half this fum, viz. 136, is the correct diff of longitude.

CASE III.

When the courfe given by the meridian difference of latitude and difference of longitude by account (taken as before) is more than five points, or 56 degrees.

RULE. To the meridian difference of latitude and difference of longitude by account, taken as difference of latitude and departure, find a diftance,

To

To this diſtance and meridian difference of latitude by obſervation, find a correſponding departure, this departure will be the correct difference of longitude.

EXAMPLE III.

Two days ago I was in latitude 43° 34′ N. and have ſince then made by account 50 miles by ſouthing, and 256 miles difference of longitude weſt, but find by obſervation that I am in 42° 30′ N.; what is my true difference of longitude?

		M. Parts.			M. Parts.
Lat. ſailed from	43° 34′ N.	2910	Lat. ſailed from	43° 34′	2910
Lat. by account	42 44 N.	2841	Lat. by obſer.	42 30	2822
	50			1 04	
Mer. diff. of lat. by account		69	Mer. diff. of lat. by obſer.		88

Then to meridian difference of latitude by account 69, and diff. of longitude by account 256 (taken as difference of latitude and departure), the diſtance is 265, and courſe 75 degrees.

And to diſtance 265, and difference of latitude 88 (the meridian difference of latitude by obſervation), the departure is 250, which is the correct difference of longitude.

Here we have given, at ſome length, the different methods of correcting the dead reckoning by an obſervation, which are readily done by the Table of Difference of Latitude and Departure.

The ſhip's way is generally greater than the diſtance given by the log, and it is always ſafeſt to have the reckoning a-head of the ſhip, that the mariner may be looking out for land, and not make it before he is aware of it.

When a great ſea ſets after the ſhip, it is common to allow one mile over for every ten given by the log, for the heave of the ſea; but if the ſea be athwart or againſt her, her diſtance muſt be leſs than that given by the log.

The error in the ſhip's reckoning is frequently attributed to unknown currents; for by various cauſes, yet undetermined, there are many counter motions of the water in the open ſeas, as well as thoſe obſerved near the ſhores, where the motions may be tolerably well accounted for. Some of the obſerved currents in the great ſeas may perhaps be owing to the tides following the moon, and to the libratory motion the waters may have thereby, and the unſettled ſetting and drift of theſe currents may poſſibly depend on the change in the moon's declination. However, it is well known from obſervations, that the trade-winds occaſion a conſiderable current within their limits, particularly within the Torrid Zone, where the motion is perpetually towards the weſt, at the rate of eight or ten miles a-day, but at the extremities of the trade-winds, or near the latitudes of 30° N. or S. it is likely that the currents are compounded of the ſaid weſtern motion, and of one towards the equator; therefore all ſhips ſailing within theſe limits ſhould allow a courſe each day for this current.

Note. When the difference of latitude by account is leſs than the difference of latitude by obſervation, the ſhip is a-head of the reckoning, but if leſs, the reckoning is a-head of the ſhip.

When the mariner is dubious of his account of longitude, he generally runs into the latitude of the intended port, and then ſails E. or W. if there be ſea room, according as it is ſituated, and keeps a good look-out for the land.

The method I have choſen to introduce the young mariner into the moſt capital part of navigation is, by ſhewing him firſt how to work a few ſeparate days' works, independent of each other, and then proceed to a continued Journal from London to Madeira and Teneriffe, in which will be inſerted moſt of the occurrences that commonly happen at ſea or in harbour.

I have ſeen many young navigators, who have been taught the principles of Navigation on ſhore, very deficient in keeping a journal at ſea; and therefore muſt requeſt the teacher not to omit putting the pupils over the following Journal, which will render them ready at working a days' work at ſea, and confirm in their memory thoſe rules they have been over.

EXAMPLE

EXAMPLE I.

Yesterday at noon we were in the latitude of 46° 28′ N. and long. 22° 18′W. and have failed till this day noon, as by the log-board, the current having all the time fet S. by E. $2\frac{1}{2}$ miles per hour; required the ſhip's place and the direct courfe and diftance made good?

LOG-BOARD.

H.	K.	F.	Courfes.	Winds.	L.Way
1	6	3	N. N. E.	W.	
2	6	2			
3	6	5			
4	6	4			
5	6	0			
6	6	1	E. N. E.	N. W.	
7	6	6			
8	5	8			
9	5	6			
10	5	4			
11	5	5			
12	5	3	E. by S.	N.	
1	5	9			
2	6	2			
3	6	0			
4	6	3			
5	6	4			
6	7	0	S. S. E.		
7	6	8			
8	7	3			
9	7	5			
10	7	1			
11	7	9			
12	7	3			

TRAVERSE TABLE.

Courfes.	Dift	N.	S.	E.	W.
N. N. E.	31	28,6		11,9	
E. N. E.	35	13,4		32,8	
E. by S.	36		7,0	35,3	
S. S. E.	51		47,1	19,5	
S. by E.	60		58,8	11,7	
		42,0	112,9	110,7	Dep.
			42,0		
		Diff. Lat.	70,9		

Lat. left	46° 28′	N.	M. Par.=3156
Diff. lat.	1° 11′	S.	
Lat. in	45 17	N.	M. Par.=3054
Sum lat. 2)91 45			Mer. D. Lat.=102
Mid. lat.	45 52		
Co. M. lat.	44 08		
Long. left	22 18	W.	
Diff. of lon.	2 39	E, or 2° 40′.	
Long. in	19 39	W.	
Direct Cou. S. 57° 22′ E. Dift. 131 m.			

The courfes and winds on the log-board being examined, it appears that the ſhip fails large and has no lee-way; therefore the feveral courfes from the log-board are entered into the Traverfe Table without alteration.

Next the fathoms and knots belonging to each courfe are fummed up, and the refults are put in the column of diftances in the Traverfe Table: and to thefe courfes and diftances, the whole differenee of latitude, departure, courfe, and diftance made good, are found as above.

Then, having the latitude left, and the latitude come to, find the complement of the middle latitude, and with that and the depdrture, find the longitude, &c. by middle latitude failing.

Or, with the courfe, and meridional difference of latitude, find the difference of longitude, by Mercator's Sailing.

Note. When the odd fathoms are above five, we allow one knot, but, if under five, nothing is allowed.

EXAMPLE II.

June 29, 1806; being yesterday noon in latitude 25° 30′ S. and longitude 10° 15′ E. we have sailed till this day noon, as per log-board, in a current setting south 2½ miles an hour, the variation 1½ point west; required the ship's place?

Log-Board.

H	K	F	Courses.	Winds.	L. Way
1	6	0	S. W.	W.N.W.	1
2	6	2			
3	6	4			
4	6	0			
5	5	3			
6	6	0	S. by W.	W. by S.	1
7	5	1			
8	5	4			
9	5	2			
10	5	3			
11	5	5			
21	5	2	S. S. W.	W.	1
1	5	2			
2	5	0			
3	4	6			
4	5	0			
5	5	1			
6	5	2	S. E. by S.	S.W. by S.	1
7	5	4			
8	5	4			
9	6	0			
10	6	0			
11	5	4			
12	5	5			

Cou. is S. 18 30 E. Dist. 174 miles.

Traverse-Table.

Courses.	Dist.	N.	S.	E.	W.
S. by W. ½ W.	30		28,7		8,7
S. by E. ½ E.	32		30,6	9,3	
S. ½ E.	30		29,9	2,9	
S.E. by E. ½ E	39		18,4	34,4	
S. by E. ½ E.	60		57,4	17,4	
	Diff. Lat.		165,0	64,0	8,7
				8,7	
				55,3	Dep.

Diff. lat.	2° 45′ S.		
Lat. left	25 30 S.	Mer. parts	1583
Lat. in	28 15 S.	Mer. parts	1768
Sum lat.	53 45	M. diff. lat.	185
Mid. lat.	26 52		
Co.m.lat.	63 08		
Long. left	10 15 E.		
Dif. Long.	1 02 E. or 1° 01′ ½ E.		
Long. in	11 17 E.		

The courses and winds on the log-board being examined, it appears that the ship is close hauled, and one point lee-way being allowed, reduces the courses, and taking a course for the current S. these several courses being corrected by the variation 1½ point west, give those in the traverse table, to which the whole difference of latitude and departure is to be found as above.

And hence the latitude and longitude in may be found, either by middle latitude or Mercator's sailing.

Note. In the two following examples, the courses are corrected to the nearest degrees, as set down in the Traverse Table, and the odd minutes are rejected.

EXAMPLE III.

Yesterday at noon we were in latitude 33° 40′N. longitude 16° 20′ west, the sun was observed to set 50° 18′ from the north point of the compass; we have sailed this day noon, as per log-board, in a current setting W. S. W. 1½ mile per hour; required the ship's place, and her course and distance to the west end of the Island of Madeira?

Log-Board.

H	K	F	Courses.	Winds.	L. Way
1	6	2	S. by W.	W.	0
2	6	0			
3	6	3			
4	7	0			
5	7	2			
6	7	3			
7	7	2	S.W.by S.	W. by N.	1
8	7	2			
9	7	4			
10	7	6			
11	7	4			
12	8	1			
1	8	0			
2	8	5			
3	8	2			
4	7	5	S.WbyW.	N. W.	0
5	7	3			
6	6	6			
7	6	4			
8	6	0			
9	6	2			
10	6	1			
11	6	3			
12	6	1			

Traverse Table.

Courses.	Dist.	N.	S.	E.	W.
S. 01° E.	40		40,0	0,7	
S. 10 W.	70		68,9		12,2
S. 44 W.	58		41,7		40,3
S. 55 W.	36		20,6		29,5
	Diff. lat.		171,2	0,7	82,0
					0,7
				Dep.	81,3

Before the courses can be corrected to put into the Traverse Table, the variation of the compass must be found from the sun's true amplitude.

The declination is 22° 30′ N.

As cos. lat. 33° 40′ : rad. : : sin. 22°30′ : sine 27° 22′. Comp. = 62° 38′.

So that the true amplitude = N. 62°38′W.
Mag. amplitude = N. 50 18 W.

Variation = 12 20 W.

The courses on the log-board being corrected by this variation and the lee-way, will give the courses fitted for the Traverse Table.

Lat. left	—	33° 40′N.
Diff. lat.	—	2 51 S.
Lat. in		30 49 N.
Sum lat.	—	64 29
Mid. lat.	—	32 14
Co. mid. lat.	—	57 46 N.
Long. left	—	16 20 W.
Diff. long.	—	1 36 W.
Long. in	—	17 56 W.

Madeira's lat.	32° 38′N.	M. parts	2073
Lat. in	30 49 N.	M. P.	1945
Diff. lat.	1 49 = 109 miles		128
Sum lats.	63 19		
Mid lat.	31 39		
Co. mid. lat.	58 21		
Madeira's long.	17 5 W.		
Long. in	17 56 W.		
Diff. long	0 51 E.		

The course N. 21 44 E. dist. 117 miles.

In the work for the amplitude, the latitude at sun-set was taken the same as at noon; for although there were about 46 miles of southing in that time, and so the latitude at sun-set was about 34° 52′, yet the amplitude being only 15′ less, the alteration in variation would scarcely affect the difference of latitude and departure found from the courses so corrected.

EXAMPLE IV.

Yeſterday, at Noon we were in Latitude 19° 30′S. and Longitude 0° 10′E. This Forenoon we obſerved the Sun's Altitude to be 10° 40′ when he was 80° 30′ from the North Point of the compaſs, Declination being then 17° 27′N. we have ſailed till this Day Noon, as per Log-board, in a current ſetting by the compaſs W.N W. ½ Mile an Hour. Required the ſhips Place, and her direct Courſe and Diſtance to the Iſland of St. Helena.

Log-Board.

H	K	F	Courſes.	Winds.	Lee-way.
1	6	7	N. by E.	E. by N.	1
2	6	2			
3	6	4			
4	6	3			
5	6	1			
6	6	0			
7	5	8	North.	E. N. E.	1
8	5	4			
9	5	0			
10	5	3			
11	5	6			
12	5	9			
1	5	7			
2	6	4	N. N. W.	N. E.	1
3	6	8			
4	7	0			
5	7	3			
6	7	6			
7	7	5			
8	7	0			
9	7	2			
10	7	4			
11	6	3			
12	6	0			

Diff. Lat.	2°06′N.	M. Parts.
Lat. left	19 30 S.	1193
Lat. in	17 24 S.	1060
Sum Lat.	2)36 54 Mer.dif.L.	133
Mid.Lat.	18 27	
	90 00	
Co.Mid.Lat.	71 33	
Longitude left	00° 10′ E.	
Diff. Long.	1 37 W.	
Preſent long.	1 27 W.	

Traverse Table.

Courſes.	Diſt.	N.	S.	E.	W
N. 13° W.	38	37.0			8.5
N. 25 W.	39	35.3			16.5
N. 47 W.	76	51.8			55.6
N. 81 W.	12	1.9			11.9
		126.0	Diff. Lat.	Dep.	92.5

Lat.	19° 30′ S.	Alt. 10° 40′	Dec. 17° 27′ N
	90 00	90 00	90 00
		Co.Alt. 79 20	P.Diſt 107 27
Co. Lat.	70 30	Co. Sec.	0,02565
Co. Alt.	79 20	Co. Sec.	0,00757
P. Diſt.	107 27		
Sum	2)257 17		
½Sum	128 38	Log. Sine	9,89274
P. Diſt.	107 27		
Rem.	21 11	Log. Sine	9,55793
			2)19,48389
Co. S. True Azimu.	= 56° 30′—9,74194		
	2		
True Azimuth	113 00 from the S.		
	180 00		
True ditto	67 00 from the N.		
Mag. Azimuth	80 30 from the N.		
Variation	13 30 W.		

Lat. in 17° 24′ S. M.P. 1060 Long. in 1° 27′ W.
St. Hel. L. 15 55 S. M.P. 968 St. Hel. lo. 5 43 W.

Diff. lat. 1 29 M.D.Lat. 92 Diff. long. 4 16
60 60

In Miles 89 In Miles 256

With the Meridional Difference of Latitude and Difference of Longitude, the direct Courſe to St. Helena is found S. 70° 14′ W. and with that Courſe and the proper Difference of Latitude the Diſtance is found 263 Miles.

A

JOURNAL OF A VOYAGE

FROM

LONDON TO MADEIRA,

AND

TENERIFFE,

IN THE

ENDEAVOR, of London;

WILLIAM CLEAR, COMMANDER;

KEPT BY

JOSEPH BRIGHT Mate.

Departure taken from the Lizard in Latitude 49° 57′N. Longitude 5° 12′ W. bound for Funchal, in Madeira, in Latitude 32° 38′N. Longitude 17° 5′ W. and to Santa Cruz, in Teneriffe, in Latitude 28° 28′ N. Longitude 10° 16′ W. bearing from the Lizard Point S. 27° 20′ W. distance 1170 Miles.

Begun April 25, 1806.

In the following JOURNAL is exemplified, the Manner of allowing for the Variation, Lee-way, Lying-to, Calms, Currents, Heave of the Sea, &c. and to correct the Dead Reckoning, by an Observation, in all Cases; with most of the Occurrences that commonly happen at Sea, and the Ship's Way pricked off on MERCATOR's CHART.

Friday April 25, 1806.	At 5 A. M. the pilot came on board; then weighed and failed from Tower Wharf; at 11 came to with the beft bower at Blackwall. Wind S. S. W.
Saturday 26.	Frefh gales and cloudy weather, with rain. At 5 A. M weighed and failed; at 9 came to an anchor at Gravefend, and cleared fhip. Wind from S. S. W. to N. N. W.
Sunday 27.	At 4 P. M. weighed and failed, moderate weather; at 9 came to with the beft bower at the Nore in $9\frac{1}{2}$ fathoms, frefh gales; at 4 A. M. weighed and failed; at 11 came to anchor in the Downs in 7 fathoms, Deal Caftle bearing W. $\frac{1}{2}$ S. diftant 3 miles. Wind W. by S.
Monday 28.	At 1 P. M. fet the Pilot on fhore. Thefe 24 hours, the firft and middle parts moderate and fair, the latter part ftrong gales and cloudy; hoifted the boats in.
Tuefday 29.	Strong gales and cloudy; at 2 P. M. veered out the long fervice of the beft bower, got top-gallant yards and maft down; at 4 P. M. ftruck yards and top-mafts. Thefe 24 hours had very hard gales of wind. Wind W. by S.
Wednefday 30.	Thefe 24 hours, for the moft part, frefh gales: at 4 A. M. hove up the beft bower, and let go the fmall bower: at 9 hove up the fmall bower, and let go the beft bower again; all hands employed righting the anchors.
Thurfday May 1.	At 6 P. M. ftrong gales with heavy rain; at 8 veered out the long fervice, and let go the fheet anchor under foot; at 9 A. M. hove up the fheet anchor. Wind variable from S by W. to W.
Friday 2.	The firft and middle parts moderate and fair; the latter part ftrong gales. Wind W. by S.
Saturday 3.	Thefe 24 hours, frefh gales and fair; at 10 A. M. got up yards, top-maft, and top-gallant mafts. Wind E. S. E.

H	K.	F.	Courses.	Winds.	Lee-way.	Remarks on board, Sunday, May 4th, 1806.
2			S.by W.$\frac{1}{4}$W.	N.$\frac{1}{2}$W.		At 2 P.M. hove short.
4						At 4 weighed and sailed in Co. with a
6						40 Gun Man of War, and 20 sail of
8						Merchantmen.
10			W.	N. by W.		At 6 S. Foreland bore N.N.W. dist. 4 M.
12			S.W.by W.$\frac{1}{4}$W.			At 2 A.M. Fairlee bore N. dist. 6 M.
2						At 6 Beachy bore N. by W. 6 Miles.
4			W.N.W.$\frac{1}{2}$W	N.$\frac{1}{2}$W.		At 8 Beachy bore N.E.by E. 9 miles.
6			W.S.W.	N. by E.		Fresh Gales and clear, several ships
8						standing up Channel; close reefed both
10						Topsails.
12						At 12 Bembridge P. bore W.N.W. 27 M. still in Company with the Fleet.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks on board Mond y, May 5
2			W.$\frac{3}{4}$S.	N. E.		
4	4	6				
6	5	5				Fresh gales and clear.
8	5	0				At 4 P.M. parted with the Fleet, they
10	5	1				being bound to Spithead. Dunnose
12	4	6				bearing W.N.W. distant 21 miles.
2	5	0				At 5 let out one reef of e ch Top-sail.
4	4	4				At 7 A.M. Portland light bore W.N.
6	4	5				W. 9 Miles.
8	4	0				At 10 A.M. it bore N.E. 12 Miles, 14
10	4	2	W. by S. $\frac{1}{2}$ W.	N.N.E.		Sail in Sight.
12	5	0				

Being upon the Coast this last Day, the Log is hove, and the Bearings and Distances of Lands, Rocks, Sands, &c. as you approach them, must always be set down, and are of the greatest consequence, especially in bad Weather, or when you are in Danger of being drove out of your true Course, in the Night, or in a Fog; so that you may at any Time determine, by your Reckoning, or the Chart, the Ship's Place, and to sail Courses and Distances as Circumstances require, in order to pass Places of Danger, and to have it always in your Power to take your Departure from some known Place, in case you should be drove out to Sea in the Night or in foggy Weather, when no Land can be seen. For it sometimes happens, that in working to Windward in the English Channel, E. of Dunnose, Ships by making too long a Board, have got upon a Sand called the Owers, on which there is now a floating Light. It is therefore absolutely necessary to have good Draughts of the Coasts you sail upon, unless you are well acquainted with them indeed.

H.	K.	F.	Courses	Winds	Lee-way.	REMARKS on board, Tuesday, May 6, 1806.
2						These 24 Hours moderate Gales and fair Weather.
4						
6						
8	4		W. S. W.	N. E.		At 6 P. M. the Lizard bore N. N. E. Distance 6 Leagues, from which I take my Depar. it being in the Lat. of 49° 57′ N. and Long. 5° 12′ West of London.
10	4	5				
12	5					
2	5					
4	5	5	S. W. by W.			Several Sail in Sight, standing to Westward.
6	5	5				
8	5	5				At Noon, Ushant N. 82° 21′ E. Distance 54 Miles.
10	5	5				
12	6					Variation 2½ Points Westerly.

Course.	Dist.	S.	W	Lat. by D. R.	Lat. by Obs	Mer. Dist.	Diff. Lon.	Long. in.	Bearing and Dist.
S. 26° 33′ W.	107	96	48	48. 21. N.		0° 48′ W.	1° 14′ W.	6° 26′ W.	Funch. S. 27° 4′ W. D. 1159 M.

The Lizard bearing N.N.E. dist. 6 Leagues from the Ship, is the same as if the Ship had sailed from the Lizard 6 Leagues or 18 Miles upon the opposite, or S.S.W. Point of the Compass, and allowing for the Variation, as before taught, makes it S. half E. dist. 18 M. which is to be set down as the first Course and Distance in the following Traverse Table.

The first Course steered by Compass is W. S. W. which, allowing for the Variation, makes S.W. by S. half W. and the Sum of all the Distances sailed on that Course till two o'Clock, when it alters, is 18 Miles and an half, which being doubled, because the Log is heaved every two hours, gives 37 Miles; so the second Course and Dist. to be set down in the Traverse Table is S. W. by S. half W. 37 Miles. In like manner the second Course steered is S. W. by W. and the Variation allowed makes it S.S.W. half W. and the Dist. on that Course summed up and doubled, gives 56 Miles; therefore the third Course and Dist. to be set down in the Traverse Table is S.S.W. half W. 56 Miles. Having found the whole Difference of Latitude and Departure made upon the several Courses, I then mark down upon my Slate or Paper what every thing that is to be found comes to, and afterwards set them down in their proper Columns as under.

TRAVERSE TABLE.

Courses.	Dist.	N.	S.	E.	W.
S. ½ E.	18		17 9	1 . 8	
S.W. by S. ½ W.	37		28 6		23 5
S. S. W. ½ W.	56		49 4		26 4
		Dif. Lat.	95 9	1 . 8	49 9
					1 8
				Dep.	48 1

Now to Diff. of Lat. 95.9S. and Dep. 48. 1 W. the Course is S. 26° 33′ W. Dist. 107 Miles; then Lat. sailed from, or Lizard's Lat. 49° 57′ N.

Diff. of Lat. 95 · 9	=		1 36 S.
Lat. in, or Ship's Lat.		—	48 21 N.
Sum. of Lats.	—	—	98 18
Middle Lat.	—	—	49 09
Com. of Middle Lat.		—	40 51

Then with this Com. of Mid. Lat. 40° 51′ or 41° found as a Course among the Degrees, and the Dep. 48. 1 in its Column, in the Dist. Col. stands 74, which is the Diff. of Long.

Or, with the Course 26 30 and Meridional Diff. of Lat. 147, the Diff. of Long. is found to be nearly 74 by Mercator's sailing.

Longitude sailed from, or Lizard's Longitude	5° 12′ W.	This being the first Day since leaving the Land, the Departure is the Mer. Dist.
Difference of Longitude 74 Miles	1 14 W.	
Longitude in, or Ship's Longitude	6 26 W.	

To find the Bearing and Distance of Ushant

Latitude in	48° 21′ N.	Mer Parts	3323	Longitude in	6° 26′ W.
Ushant's Lat.	48 28 N.	Mer. Parts	3334	Ushant's Long.	5 4 W.
Difference of Lat.	7	Mer. Diff. of Lat.	11	Diff. of Long.	1 22

With the Mer. Diff. and Diff. Long. Ushant is found to bear N. 82° 22′ E. and with that Bearing, taken as a Course, and the proper Difference of Latitude, the Distance is found 53 Miles.—The Bearing and Distance to Funchal is found in the same manner.

H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on board, Wednesday, May 7, 1806.
2	6		S.W by W ¾ W	N.		These 24 hours moderate gales, and cloudy weather.
4	5	5				
6	5			N. W.		At 4 P.M. spoke the Charming Nancy, from South Carolina, bound to London.
8	5					
10	3	6	S. W. ¼ W.			
12	3	4				
2	3	4				At 6 A.M. got the bower anchors on the gunnel, and unbent the cables and stowed them.
4	4	5				
6	4	6				
8	5		S.W. by S ¾ W	W. N. W.		At noon C. Ortegal bore S. 0° 27′ E. dist. 181 miles.
10	4	5				
12	4					Variation 2¼ points westerly.

Course.	Dist.	Diff. Lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Mer. Dist.	Diff. long.	Long. in	Bearings and Distance.
		S.	W.	N.		W.	W.	W.	Funchal S. 26° 44′ W.
S. 30° W.	108	93	53	46 48		1 41	1° 19′	7° 45	Distance 951 Miles.

The Variation being allowed on each Course, and the Distances summed up, as before taught, the Traverse Table will stand thus:

With the difference of latitude and departure the course is found S. 30° 0′ W. and the distance 108 miles.

Diff. of latitude	1° 33′ S.		Mer. parts.
Latitude left	48 21 N.		3323
Latitude in	46. 48 N.		3181
Sum lat.	65 09	Mer. Diff. L.	138
Middle latitude	47 34		
	90 00		
Com. mid. lat.	42 26		

TRAVERSE TABLE.

COURSES.	Dist	N.	S.	E.	W.
S.W by S ¾ W.	43		33·2		27·3
S.S.W. ¼ W.	39		34·4		18·4
S. by W. ½ W.	27		25 9		7·8
		Diff lat.	93·5	Dep.	53·5

The Diff. of Long. is found by Mercator's, or Middle Latitude Sailing, to be		1° 19′ W.
Yesterday's Longitude		6 28 W.
Longitude in	—	7 47 W.

This Day's Departure being added to the Mer. Distance Yesterday, gives 1° 41′, the Mer. Dist. to-day.

To find the Bearing and Distance of Cape Ortegal.

Latitude in	46° 48 N.	Mer. parts.	3185	Longitude in	7° 45′ W.
Cape's latitude	43 47 N.	Mer. parts.	2928	Cape's long.	7 43 W.
Difference of lat.	3 1	Mer. dif. lat.	257	Dif. long.	2
In Miles	181				

With the merid. diff. of lat. and diff. of long. the direct course to Cape Ortegal is S. 0° 27′ E. and with that course, and the proper difference of latitude, the distance is 181 miles.

NOTE. As the Table of Difference of Latitude and Departure are only calculated to single Degrees, the nearest Degree to the Com. of Middle Latitude is to be taken in working by Inspection to find the Difference of Longitude by: thus the Com. of Mid. Latitude is 42° 26′, for which I take 42° to find the Difference of Longitude. The same may be observed in finding the Course made good, the nearest Degree or ½ Degree to the Course is always set down, and will be found sufficiently exact.

H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on board, Thursday, May 8, 1806.
2	5		W.S.W.½S.	N.W.	0	These 24 hours moderate gales and clear weather.
4	4	5				
6	4	5				At 6 P. M. saw a ship to the westward.
8	4	4	S.W. by S.	W. by N.	½	90
10	4	5				Observed sun's mer. alt. at noon 61 35
12	4	6				
2	4	5				Zenith distance - 28 25 S.
4	4		S. S. W.	West.	1	Declination - 16 58 N.
6	4					
8	4					Latitude - - 45 23 N.
10	4					At noon C. Ortegal S. 10°21′ E. dist. 99 M.
12	4					Variation 1½ point westerly.

Course.	Dist.	Dif. lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Mer. Dist.	Dif. of Long.	Long. in.	Bearing and dist.
		S.	W.	N.	N.	W.	W.	W.	Funchal S. 28°34′ W
S. 13° W.	97	96	22	45.12	45.23	51	00.30	8 6	Dist. 871 Miles.

By allowing for variation and lee-way the work will be as follows:

With the diff. of lat. and dep. the course is found S. 8°30′ W. and the dist. 97 miles.

Dif. of lat.	1° 36′ S.		Mer. parts.
Lat. left	46 48 N.		3185
			3047
Lat. in by D. R.	45 12	=	
		Mer. diff. lat.	138
Sum lat.	2)92 00		
Mid. lat.	46 00		
	90 00		
Com. mid. lat.	44 00		

TRAVERSE TABLE.

Courses.	Dist.	N.	S.	E.	W.
S. W. ¼ S.	28		20.7		18.3
S. by W.	36		35.3		7.0
S. ½ E.	40		39.8	3.9	
	Dif.	lat.	96.3	3.9	25.8
					3.9
				Dep.	21.9

Longitude left	7° 45′ W.
Difference of longitude	30 W.
Longitude in by account	8 15 W.

Here the latitude, by observation, differing from the latitude by account, I correct for the true longitude; and as this is the first observation got since leaving the land, I correct by Case I. as follows:

Lizard's lat.	49° 57′ N.	Mer. parts	3470
Lat. by D. R.	45 12 N.	Mer. parts	3047
Mer. diff. lat. by account			423
Lizard's long.	5° 12′ W.		
Long. in by account	8 6 W.		
Diff. of long. by account	2 54		
	60		
In miles - -	174		
Lizard's lat. 49° 57′ N.		Mer. parts	3470
Obs. lat. 45 23 N.		Mer. parts	3063
Mer. diff. lat. by observation			407

With the mer. diff. of lat. and diff. of long. by account, the ship's direct course from the Lizard is found to be S. 23° W.

With that course, and the mer. diff. of lat. by observation, the diff. of long. since leaving the Lizard is found 174 miles, equal to 2° 54′ W.

Lizard's longitude	5 12 W.
Longitude in	8 06 W.

With the course 23°, the proper diff. of lat. 274 miles, the true mer. dist. is found 113 miles.

To find the direct Course and Distance to Cape Ortegal.

Lat. in	45° 23′ N.	Mer. parts	3063	Longitude in	8° 06′ W.
Cape's lat.	43 47 N.	Mer. parts	2926	Cape's longitude	7 43 W.
Dif. lat.	1 36	Mer. dif.	135	Dif. longitude	0 23

With the mer. diff. of lat. and diff. of long. the direct course to Cape Ortegal is found S. 10° E. and with that course and the proper dif. of lat. 96, the distance is found to be 98 miles.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks on board, Friday, May 9, 1806.
2	3	5	S. by W. ¾ W.	West.	1	These 24 hours moderate gales and clear weather.
4	3	5				
6	3	5				
8	2					At 8 P. M. set up the mizen top-mast shrouds, and back-stays.
10	3	5				
12	2					At noon Cape Ortegal S. 12° E. distance 22 miles.
2	3					
4	2					
6	3		S. by W.	W. by S.	1	Variation 1½ point westerly, per amp.
8	4					
10	4					Thick hazy weather.
12	4					Down top-gallant yards.

Course.	Dist.	Dif. lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Mer. Dist.	Dif. of Long.	Long. in.	Bearing and dist.
S. 9° E.	76	75 S.	12 E.	N. 44.08		W. 1.46	17 E.	7° 49′ W.	Funchal S. 32° 10′ W. dist. 815 miles.

With the diff. of lat. and dep. the course is found S. 9° E. and the dist. 76 miles.

Dif. of lat.	1° 15′. S.		Mer. parts
Yesterday's lat.	45 23 N.		3063
			2957
Lat. in	44 08 N.		
Sum lats.	2)89 31	Mer. diff. lat.	106
Mid. lat.	44 45		
	90 00		
Com. mid. lat.	45 15		

Traverse Table.

Courses.	Dist.	N.	S.	E.	W.
S. ½ E.	46		45.8	4.5	
S. by E. ¼ E.	30		29.1	7.3	
	Diff. Lat.		74.9	11.8	Dep.

Yesterday's longitude	8° 06′ W.
Difference of longitude	0 17 E.
Longitude in	7 49 W.

This day's departure being subtracted from the meridional distance of yesterday, gives 1° 46′, the meridional distance of to-day.

To find the Bearing and Distance of Cape Ortegal.

Latitude in	44° 08′ N.	Mer parts	2957	Longitude in	7° 49 W.
Cape's lat.	43 47 N.	Mer. parts	2928	Capes longitude	7 43 W.
Diff. lat.	21	Mer. diff. lat.	29	Diff. long.	6 E.

With the mer. difference of latitude and difference of longitude, Cape Ortegal is found to bear S. 12° 0′ E. and with that bearing taken as a Course, and the proper difference of latitude, the distance is found 22 miles.

Note. When the tenths on any side are more than 5, or half a mile, you must call that side one more than you found it to be; but when they are less than 5, then you need not take notice of them; as in the above the difference of latitude and departure are 74.9 and 11.8, which I call 75 and 12, because the Tenths are above 5.

But when you take the difference of latitude and departure to find the Course, then take them in Miles and Tenths; the same may be observed in casting up the Knots and fathoms.

If, when doubled, the Tenths are more than 5, set one mile more in the Traverse Table; but if less, omit them, as there are no Tenths in the distance column.

H.	K.	F.	Courses.	Winds.	Leeway.	Remarks on Board, Saturday, May 10, 1806.
2	3	5	West.	S. S. W.	3	These 24 hours hard gales and squally, with small rains.—Handed the fore and main courses.
4	3	5				
6	3	5				
8	Lay to up N. W. by N. off N. by E.				5	At 8 P.M. saw a ship to windward under jury masts.
10	Drift 1 ½ mile per hour W.					
12						
2	Up N. W. off North.			W. by S.	5	More moderate.
4	Drift 1 ½ mile per hour.			Wore ship.		
6						Set the reefed courses.
8	4		S. W.	N.W. by W. ½ W.	1½	Set the top-sails close reefed.
10	5					C. Finisterre S. 31° 24′ W. dist. 83 m.
12	5					Variation 1 ½ point westerly.

Course.	Dist.	Diff. Lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Mer. Dist.	Diff. of Long.	Long. in	Bearing and dist.
W. S. 79°	20	S. 4	W. 25	N. 44° 04′		2.11	W. 31	8.20 W.	Funchal S. 30° 53′ W. Dist. 99 miles.

Taking the middle points (viz. N. by W. and N. N. W.) between the point to which the ship comes up, and the point she fell off to for the second and third courses, as taught in the rules for lying to, and then allowing as before for variation and leeway, the Traverse Table will stand as follows:

With the diff. of lat. and dep. the course is found S. 81° 21′ W. and the dist. 25 miles.

Diff. of Lat.	00°	04′ S.	Mer. parts.	
Yesterday's lat.	44	08 N.		2957
Latitude in	44	04 N.		2951
Sum Lats.	88	12	Mer. diff. lat.	6
Middle Latitude	44	06		
	90	00		
Com. Mid. Lat.	45	54		

Traverse Table.

Courses.	Dist.	N.	S.	E.	W.
W. N. W. ¼ W.	21	7.1			19.8
N. N. E. ¾ E.	9	7.7		4.6	
N. by E. ½ E.	9	8.5		3.0	
S. by W. ¾ W.	28		27.2		6.8
		23.3	27.2	7.6	26.6
			23.3		7.6
	Diff. Lat.		3.9	Dep.	19.

The departure to-day being added to the mer. dist. yesterday, gives 2° 11′, the mer. dist. to-day.

With the course and mer. diff. of lat. the diff. of long. is found by Mercator to be 31 miles. Or, with the mid. lat. and dep. the diff. of long. is found by mid. lat. sailing 27 miles west.

Diff. longitude	0°	31′
Yesterday's longitude	7	49 W.
Longitude in	8	20 W.

Here the dif. of long. found by mid. lat. differs considerably from that found by Mercator's sailing, but if the mer. parts were taken from a table of miles and tenths it would agree nearer with mid. lat. sailing; but in all cases where the course is so great, and the difference of latitude is in miles and tenths, middle latitude should be depended on.

To find the Bearing and Distance of Cape Finisterre.

Latitude in	44° 04′ N.	Mer. parts	2951	Longitude in	8° 20′ W.
Cape's latitude	42 53 N.	Mer. parts	2854	Cape's long.	9 18 W.
Diff. latitude 71 =	1 11	Mer. diff. of lat.	97	Diff. long.	58

With the mer. diff. of lat. and diff. of long. Cape Finisterre is found to bear S. 31° 24′ W. and with that bearing and the proper diff of lat. the distance is found 83 miles.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks on Board, Sunday, May 11th, 1806.
2				Calm		The first 8 hours calm and foggy.
4						Up T. G. Y. out reefs, set T. G. S.
6						Hoisted the boat out, and tried the cur-
8						rent, found it to set N. W. by N. 1 mile
10	3	5	W. S. W.	South.	1	per hour.
12	4	4				Moderate and clear.
2	4	6				
4	4	8				
6	4	6				Variation $1\frac{1}{4}$ point westerly.
8	4	8				
10	4	8				Cape Finisterre S. 38° 10′ dist. 53 Miles.
12	4	5				

Course.	Dist.	Dist. Lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Mer. Dist.	Diff. of Long.	Long. in.	Bearing & dist.
S. W. 80°.	84	S. 15	W. 83	N. 43.49	N. 43.34	W. 3.26	W. 1.55	W. 10.2	Funch. S. 76° 49 W. dist. 735 M.

The variation and lee-way being allowed on the course steered, and the setting of the current and its drift in 24 hours being made a course and dist. the work will be as follows:

With the diff. of lat. and dep. the course is found S. 79° 57′ W. and the dist. 84 M.

Diff. of latitude	00° 15′ S.		Mer. parts.
Lat. left	44 4 N.		2951
Lat in	43 49 N.		2931
Sum of lats.	87 53	Mer. dif. lat.	20
Middle lat.	43 56		
	90 00		
Com. mid. lat.	46 04		

TRAVERSE TABLE.

Courses.		N.	S.	E.	W.
N. W. $\frac{1}{4}$ W.	24	16.1			17.8
S. W. by W. $\frac{1}{4}$ W.	72		30.8		65.1
		16.1	30.8	Dep.	82.9
			16.1		
	Diff. Lat.		14.7		

The diff. of long. found by Mercator's sailing is 113 miles, but by mid. lat. is found 115 miles, equal to — — — 1° 55′ W.
Longitude left — — — — 8 20 W.

Longitude in by account — — 10 15 W.

The diff. of long. found by mid. lat. still differs from that found by Mercator's sailing; the cause is the same as before, and as the ship has made so great a course, we still depend on mid. lat.

The lat. by observation differing from the lat. by account, I correct for the true longitude as follows (it being three days since I had an observation before) by Case II. p. 182.

Last obs. lat.	45° 23′ N M. pts.	3063
Ship's lat. by acc.	43 49 N.	2931
Mer. diff. lat. by account		132
Ship's long. at last observ.	8° 6′ W.	
Ship's long. in by acc. to-day	10 15 W.	
Diff. long. since last obs.	2 9 W.	
Last obs. lat.	45° 23′ N.	3063
Ship's lat. by obs.	43 34 N.	2910
Mer. diff. by obs.		153

With the mer. diff. lat. by acc. 132 and diff. of long. by account 129, the direct course since last obs. is found S. 44° 21′ W. and the dist. 132 miles.—With that dist. and the mer. diff. of lat. by obs. 153, the dif. long. is found 104, this added to the diff. of long. by account 129, gives 233, which divided by 2, gives the true diff. of long. since last obs. 116 M. nearly equal to 1° 56′ W.
Long in last observation 8 6 W.
Long. in 10 2 W.

The course found since last observation 44° 21′ is of no farther use than to know what Case to correct by.

With the true course since last obs. 37° 10′ and the proper diff. of lat. 109, the dep. is 1° 23′ + 2° 3′ W. = 3° 26′.

To find the Bearing and Distance of Cape Finisterre.

Latitude in	43° 34′ N.	Mer. Parts	2910	Longitude in	10° 02′ W.
Cape's Lat.	42 52 N.	Mer. Parts	2852	Cape's Long.	9 14 W.
Difference of Lat.	42	Mer. Diff. of Lat.	58	Diff. of Long.	48

With the mer. diff. of lat. and diff. of long. the direct course to Cape Finisterre is found S. 38° 10′ E. and with that course and proper diff. of lat. the distance is found 53 miles.

H.	K.	F.	Courfes.	Winds.	Lee-way.	REMARKS on board, Monday, May 12, 1806.
2	4	5	S.W by W.	S. by E.	1	Thefe 24 hours moderate gales, with fmall fhowers of rain.
4	4	5				
6	4	5				
8	4					
10	4					
12	4					
2	3	5				
4	3	5	S.W.	S.S.E.	1	
6	3	5				Var. per. Az. 1 point weft.
8	3					
10	3					A great fwell from the S. W. for which I allow 6 miles. —Hazy weather.
12	3					

Courfe	Dift.	Diff. Lat.	Dep	Lat. by D. R.	Lat. by Obf.	Mer. Dift.	Diff. Long.	Long. in.	Bearing and Dift.
S. 53° 30′ W.	84	S. 50	W. 67	N 42.44		W. 4.34	W. 1.33	W. 11.35	Funchal S. 23° 15′ W. Dift. 655 Miles.

In this day's work the fwell is confidered as a current, whofe drift in 24 hours is 6 miles, the allowance made for the fwell; and as it comes from the S.W. it heaves the fhip towards the N. E. and the variation allowed upon it makes the laft courfe N. E. by N. as in the Traverfe Table.

With the diff. of lat. and dep. the courfe is found S. 53° 30′W. and the dift. 84 miles.

Diff. lat.	0° 50′S.		Mer. parts.
Lat. left	43 34 N.		2910
Lat. in	42 44		2841
Sum lat.	86 18	Mer. diff. lat.	69
Middle lat.	43 09		
	90 00		
Com. mid. lat.	46 51		

TRAVERSE TABLE.

Courfes.	Dift.	N.	S.	E.	W.
S. W. by W.	58		32.2		48.2
S. W.	32		22.6		22.6
N.E. by N.	6	5.0		3.3	
		5.0	54.8	3.3	70.8
			5.0		3.3
	Diff.	lat.	49.8	Dep.	67.5

The dep. 68 being added to yefterday's mer. dift. gives 4° 34′ the mer. dift. this day.

The difference of longitude is found as before to be	1° 33′W.
Yefterday's longitude	10 2 W.
Longitude in this day	11 35 W.

To find the Bearings and Diftance of Funchal.

Latitude in	42° 44′N.	Mer. parts	2841	Longitude in	11° 35′W.
Funchal's lat.	32 38 N.	Mer. parts	2073	Funchal's long.	17 5 W.
Dif lat. 606 =	10 6	Mer. dif. lat.	768	Dif. long. 330 =	5 30

With the mer. dif. of lat. and dif. long. Funchal is found to bear S. 23° 15′ W. and with that bearing taken as before, and the proper dif. of lat. the diftance is 655 miles.

To find the Bearing and Diftance of the intended Port on Mercator's Chart.

Lay a ruler acrofs Mercator's Chart, in lat. 42° 44′, and fet one foot of the compaffes on the meridian of London, and the other in long. 11° 35′W. lay off that fame diftance from the meridian of London, by the edge of the ruler, and that will fhew you the fhip's place. Then lay the ruler over the fhip's place and Funchal, and take the neareft diftance between the ruler and the centre of the compafs; flide one foot along the fide of the ruler, and the other foot will fhew the courfe to be S. S. W. Again, (keeping the ruler as before) take from the graduated parallel the diff. of lat. between the fhip and port (10° 12′) in your compaffes, and flide one foot along the ruler, holding both points parallel to the N. and S. lines, till the other cuts the E. and W. lines; paffing through the fhip's place; the diftance between where the point refted, by the edge of the ruler, and Funchal, being meafured upon the graduated parallel, gives nearly 11°, or 660 miles for the diftance. In like manner find the bearing and diftance of any other place from the fhip; or take the diftance between Funchal and the fhip in your compaffes, and lay it on the meridian, placing one foot as much above Funchal as the other is below the fhip's place, and that will be the dift. in degrees or in leagues, if the merid. is marked fo.

H.	K.	F.	Courſes.	Winds.	Lee way.	Remarks on board, Tueſday, May 13, 1806.
2	4	5	W.	S. S. W.	1	Theſe 24 hours freſh gales, and clear weather.
4	4	5				
6	4	5				
8	5					
10	5					
12	5					
2	5	5				
4	5	5	W. ½ N.	S.S.W.½W.	½	
6	5	5				
8	5	5				
10	5	5				
12	4					Variation 1 point weſterly.

Courſe.	Diſt.	Diff. Lat.	Dep.	Lat. by D. R.	Lat. by Obſ.	Mer. Diſt.	Diff. long.	Long. in	Bearing and Diſt.
			W.	N.	N.	W.	W.	W.	Funchal S. 12° 48′ W.
W.	120		120	42 44	42 30	6.30	2.43	14.15	Diſtance 607 Miles.

The variation being allowed on both the courſes, and the leeway upon the ſecond, it will be found that the ſhip has ſailed due Weſt theſe laſt 24 hours, and by ſumming up the diſtances her whole diſtance is found to be 120 miles, which is alſo her departure; it is evident ſhe has made no difference of latitude, therefore her latitude by account is the ſame as yeſterday.

As the ſhip has ſailed upon a parallel with the Equator, her difference of longitude is found by parallel ſailing 2° 43′W.

Yeſterday's longitude 11 35 W.

Longitude in by account 14 18 W.

The latitude by obſervation not agreeing with the latitude by account, and it being two days ſince my laſt obſervation, I correct as follows, by Caſe III. Page 182:

Laſt obſ. lat. 43° 34′ Mer. parts 2910
Lat. in by acc. 42 44 Mer. parts 2841

Mer. dif. lat. by account ſince laſt obſ. 69

With the mer. dif. of lat. and dif. long by account, the courſe ſince laſt obſ. is found to be S. 75 W. and the diſtance 266 miles.

Long. in at laſt obſervation 10° 02′W.
Ship's long. by account 14 18′W.

Dif. long. by acc. ſince laſt obſ. 4 16 W.

With that diſt. and the mer. dif. of lat. by obſ. the true dif. of long. ſince laſt obſervation is found to be 253 = 4° 13′W.
Long. in at laſt obſervation 10 2 W.

Longitude in 14 15

Laſt obſ. lat. 43° 34′ M. parts 2910
Thisday'slat.byobſ. 42 30 M. parts 2822

Mer. dif. lat. by obſ. ſince laſt obſ. 88

With the courſe ſince laſt obſervation S. 70° 49′W. and the proper dif. of lat. 64 miles, the departure (or Mer. diſt.) ſince laſt obſervation is found 184 miles, equal to 3° 04′W.

Mer. diſt. at laſt obſ. 3 26 W.

True Mer. diſt. this day 6 30 W.

To find the Bearing and Diſtance of Funchal in Madeira.

Latitude in	42° 30′N.	Mer. parts	2822	Longitude in	14° 15′W.
Funchal's lat.	32 38 N.	Mer. parts	2073	Funchal's long.	17 5 W.
Dif. lat. 592 =	9 52	Mer. dif. lat.	749	Dif. longitude	2 50 = 170

With the mer. difference of latitude and difference of longitude the bearing of Funchal is found to be S. 12° 48′W. and with that bearing taken as before, and the proper dif. of latitude, the diſtance is found 607 miles.

H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on Board, Wednesday, May 14th, 1806.
2	8		S. S. W.	N. W.		Stiff gales, with showers of rain.
4	8					Fresh gales.
6	8	5				
8	8	5				
10	8	5				
12	8	5				
2	9	0				Ditto weather.
4	6	0	S. ¼ E.	S.W.byW.¾W.	½	More moderate.
6	5	5				Var. p. amp. 1 point westerly.
8	5	5				
10	5					
12	5					

Course.	Dist.	Diff Lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Mer. Dist.	Diff. Lon.	Long. in.	Bearings and Dist.
South.	170	S. 170		N. 39.46	N. 39.40	W. 6.30		W. 14 15	Funchal S. 17° 59' W Distant 444 miles.

Yesterday's lat.	42° 30' N.	
Diff. lat.	2 44 S.	
Lat. in by acc.	39 46 N.	

TRAVERSE TABLE.

Courses.	Dist.	N.	S.	E.	W.
S. by W.	118		115.7		23.0
S. S. E. ¼ E.	54		48.8	23.1	
	Diff. Lat.		164.5	23.1	23.0
				23.0	
				0.1	Dep.

Proper allowances being made for variation and lee-way, it appears from the Traverse Table that the ship has sailed due South 164½ miles, and as she made no departure, her longitude in and mer. dist. is the same as yesterday; but as by observation the ship is found to be in lat. 39° 40' N. it is plain she has got 6 miles a-head of her reckoning, which 6 miles being added to the distance by D. R. gives the true distance and diff. of lat. as above.

To find the direct Course and Distance of Funchal.

Latitude in	39° 40' N.	Mer. Parts	2597	Longitude in	14° 15' W
Funchal's lat.	32 38 N.	Mer. Parts	2073	Funchal's long.	17 5 W.
Diff. lat. 422 =	7 2	Mer. diff. lat.	524	Diff. long. 170 =	2 50

With the mer. dif. lat. 524, and the dif. of long. in miles 170, the direct course to Funchal is found S. 17° 59', or 18° W. and with that course and the proper dif. of lat. 422, the distance is found to be 444 miles.

Now a parallel of lat. through 39° 40' on the variation chart, cuts the variation lines in 21° 15' in longitude 14° 0' W. which confirms the longitude by account.

The variation charts might be of great use were they drawn upon a large scale, and the lines of variations well laid down, but as the variation in most places is continually altering, it renders them in a few years useless: I would therefore advise the Mariner to trust more to his reckoning and lunar observations, since the theory of the variation is not yet known.

H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on board, Thursday, May 15, 1806.
2	8		S. S. W. ¾ W.	W. by N. ¼ W	½	Fresh gales and clear weather.
4	8					
6	8	5				
8	8	5				
10	8					
12	8	5				Ditto weather.
2	8	4				
4	8	4				
6	8	6				Variation ¼ point W. per Azimuth.
8	8	6				
10	8	5				
12	8					

Course.	Dist.	Dif. lat.	Dep.	Lat. by D.R.	Lat. by Obs.	Mer. Dist.	Diff. Long.	Long. in.	Bearing and dist.
S. by W. ½ W	192	S. 184	W. 56	N. 36.29	N. 36.36.	W. 7.26	W. 1.11	W. 15.26	Funchal S. 16°51' W. distant 252 M.

By examining the Log-Board, it appears that the ship has sailed S. S. W. ¾ W. 200 miles.

Latitude left	39° 40'N.	
Dif. latitude	3 11 S.	
Lat. in by account	36 29 N.	

TRAVERSE TABLE.

Courses.	Dist.	N.	S.	E.	W.
S. by W. ½ W.	200	Dif. lat.	191.4	Dep.	58.1

The latitude by observation not agreeing with the latitude by D. R. I correct as follows, by Case I. page 179.

With the course one point and a half, and the dif. of lat. by obs. 184. the dist. is found to be 192 miles, and the dep. 56, which being added to the mer. dist. yesterday, 6° 30' W gives the mer. dist. to-day 7° 26'W.

Yesterday's latitude	39° 40'N.	Mer. parts	2597
This day's obs. lat.	36 36 N.	Mer. parts	2363
Sum of latitudes	76 16	Mer. diff. lat.	234
Middle latitude	38 8		
	90 00		
Comp. mid. lat.	51 52		

The diff. long. is found by Mercator or mid. lat.	1° 11'W.
Yesterday's long.	14 15 W.
Long. in this day	15 26 W.

To find the Bearing and Distance of Funchal.

Latitude in	36° 36'N.	Mer. parts	2363	Longitude in	15° 26'W.
Funchal's lat.	32 38 N.	Mer. parts	2073	Funchal's long.	17 05 W.
Dif. lat. 238 =	3 58	Mer. dif. lat.	290	Dif. long. 99 =	1 39

With the mer. diff. of lat. and the diff. of long. the bearing of Funchal is found, and with that bearing and the proper diff. of lat. the distance is found 252 miles.

H.	K.	F.	Courses	Winds.	Lee-way.	REMARKS on board, Friday, May 16, 1806.
2	4	3	W. by S.	S. by W.	1	These 24 hours moderate weather, with rain and much swell.
4	4	5				
6	4	7				
8	5		W. S. W. ¼ W.	S. ¼ W.	¼	Less swell.
10	5	2				
12	5	3				
2	5	5	W. S. W.	South	½	
4	5	5				Pleasant weather.
6	5	4				
8	5	1				
10	5		S. W. by W.	S. by E.	½	
12	4	5				Varia. ¾ W. per equal alt. of the sun.

Courses.	Dist.	Dif. Lat.	Dep.	Lat by D. R.	Lat. by Obs.	Mer. Dist.	Diff. of Long.	Long. in	Bearing and Dist.
S. 65° W.	119	S. 50	W. 108	N. 35 52	W. 35 46	W. 9 14	W. 2 13	W. 17 39	Funch. S. 8° 29′ E. Dist. 190 miles.

With the diff. of lat. and dep. the course is found S. 68° 10′W. and the dist 118.6 miles

Yesterday's lat.	36° 36′N.	
Diff. of latitude	44 S.	
Lat. by account	35 52 N.	
Yesterday's lat.	36° 36′N.	M. parts 2363
Obs. lat.	35 46 N.	M. parts 2301
Diff. lat. by Obs.	50	M. diff. lat. 62
Sum lats.	72 22	
Middle lat.	36 11	
	90 00	
Com. mid. lat.	53 49	

TRAVERSE TABLE.

Courses.	Dist.	N.	S.	E.	W.
W. by S. ¼ W.	27		4 0		26.7
W. S. W. ¼ W.	31		10 4		29.2
S W. by W. ¼ W.	43		18 4		38.9
S. W. ¼ W.	19		11 3		15 3
			Diff. lat. 44.1		Dep. 110 1

The latitude by observation not agreeing with the latitude by account, I correct as follows, by Case III. page 180.

With the proper diff. of lat. by obs. 50′ and the distance 119.9 the true course is found 65° 04′. and the departure 108 miles, nearly.

The departure 108 being added to the mer. dist. yesterday, gives 9° 14′W. the mer. dist. to-day.

With the comp. of mid lat. and dep. or with the course and mer. diff. of lat. 62, the diff. of long. is found by middle latitude or Mercator's sailing, to be 133 miles = 2° 13′W.

Yesterday's longitude	15 26 W.
Longitude in —	17 39W.

To find the Bearing and Distance of Funchal in Madeira.

Lat. in	35° 46′N.	Mer. parts	2301	Longitude in	17° 39′W.
Funchal's lat.	32 38N.	Mer. parts	2073	Funchal's long.	17 05 W.
Dif. lat. 188 =	3 8	Mer. dif. of lat.	228	Dif. longitude	34 E.

With the mer. diff. of lat. 228 and diff. of long. 34, Funchal is found to bear S. 8° 29′E. and with that bearing (taken as before) and the proper diff. of latitude, the distance is found 190 miles.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks on board, Saturday, May 17, 1806.
2	6	6	S. by E. ½ E.	S. W. ½ W.	½	These 24 hours moderate gales, and clear weather.
4	5	8				
6	5	8				
8	5	8				
10	5		S. S. E.	S. W.	½	
12	5	2				
2	5	3				
4	5	5	S. S. E. ½ E.	SW by S ½ W.	½	
6	5	5				Var. ½ point westerly.
8	5	5				
10	5	6	S.E. by S.	S.W. by S.	½	Unstowed the Anchor and bent Cables.
12	5	4				

Course.	Dist.	Diff. Lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Mer. Dist.	Diff. long.	Long. in	Bearing and Distance.
		S.	E.	N.	N.	W.	E.	W.	Funchal S. 32° 7′ W.
S 35° 20′ E	135	110	78	34.01	33.56	7.47	1° 33′	16 01	Distance 92 Miles.

With the diff. of lat. and dep. the course is found S. 37° 48′ E. and the dist. 133 miles.

Yesterday's lat.	35° 46′ N.		
Diff. of latitude	1 45 S.		
Lat. by account	34 01 N.		
Obs. lat.	33 56 N.	M. parts	2167
Yesterday's lat.	35 46 N.	M. parts	2301
Prop. diff. lat. obs.	1 50	M. dif. lat.	134
Sum of lat.	69 42		
Middle latitude	34 51		
	90 00		
Comp. mid. lat.	55 09		

Traverse Table.

Courses.	Dist	N.	S.	E.	W.
S. S. E. ½ E.	48		41.2	24.7	
S.E. by S. ½ E.	31		24.9	18.5	
S.E. by S. ½ E.	33		24.4	22.2	
S. E. ½ E.	22		14.8	16.3	
	Diff.	lat.	105.3 S	81.7	Dep.

The latitude by obs. differing from the latitude by account, I correct as follows, by Case II. page 170.

With the diff. of lat. 110 and the dist. 133, the dep. is found to be 75, which being added to the former dep. 82, gives 157, half this sum is the true dep. 78 miles; with the dif. of lat. 110 and the depth 78, the true course is found S. 35° 20′ E. and the dist. 135 miles.

The dep. 78 being subtracted from the mer. dist. yesterday, gives 7° 49′ W. the mer. dist. this day.

The dif. of long. is found by Mercator or middle latitude sailing, to be 1° 35′ E.

Yesterday's longitude	17 39 W.
Longitude in	16 06 W.

To find the Bearing and Distance of Funchal in Madeira.

Latitude in	33° 56 N.	Mer. parts	2167	Longitude in	16° 06′ W.
Funchal's lat.	32 38 N.	Mer. parts	2073	Funchal's long.	17 05 W.
Difference of lat.	1 18	Mer. dif. of lat.	94	Dif. of long.	0 59

With the merid. diff. of lat. and diff. of long. the direct course to Funchal is S. 32° 7′ W. and with that course, and the proper difference of latitude, the distance is found 92 miles.

H	K.	F	Courses.	Winds.	Lee-way.	REMARKS on Sunday, May 18, 1806.
2	5	5	S. ¼ W.	E. N. E.		Moderate and hazy.
4	5	5				
6	4	5				
8	4	5				
10	5	4				
12	5	4				Made Porto Santo to the westward.
2	5		W. by S.	N.N.E.		Hauled round the S. end, and steered for Funchal.
4	5					
6	5					Cleared up, made the Island Madeira
8	5					Anchored in Funchal-road, hoisted out the boat, and waited on the Governor.
10	5			N N W.		
12						

Course.	Dist.	Diff. Lat.	Dep.	Lat. by Acc.	Lat. by Obs.	M. Dist.	Diff. Long.	Long. in	Bearing and Distance.
S. 32 W.	90°	S. 78.3	W. 47	N. 32° 38′		W. 8° 36′	W 58	W 17 4	Off Funchal ½ Mile.

The variation allowed upon the course, with the distance run upon each course put into a Traverse Table, will produce the difference of lat. and dep. as above with the complement of the middle latitude and departure, the difference of longitude is 58, which added to 16° 6, the longitude in yesterday at noon, gives 17°4′, the longitude in by account; and as it agrees with the longitude of Funchal in the table I conclude that my reckoning is just, and Funchal well laid down.

The ship's place in the preceding Journal is pricked off, and the bearing and dist. at noon are also found by the chart, in order to shew the young Navigator the method, and may be done with a black lead pencil, which he may either let stand or rub out when he pleases.

Between May 18, and June 3, lay moored in Funchal Road, Madeira.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks on Board Tuesday June 3, 1806.
2				N. E.		Fresh Breezes and clear. At four P.M. unmoored ship and hove in ½ of a cable on the best bower.
4						
6						
8						
10						
12						Light Breezes and clear.
2						At 6 A. M. weighed from Funchal Road and made sail.
4						
6						Variation 18 30 W.
8						
10						Ditto W. at noon the S. most Deserta, N. W. by N. ¼ W. 7 or 8 leagues.
12						

Course.	Dist.	Dif. Lat.	Lat. by D.R.	Dep.	Lat. by Obs.	Mer. Diff.	Diff. of Long.	Long. in	Bearing and Distance.
					32° 10 N.				Southernm. Des. to N. W. 5 leags.

I take my departure from the Southernmost Deserta, which lies in latitude 32° 22″ N. long. 16° 36′ W.

The first course in the next Traverse Table must be the opposite Point of the Bearings of the Deserta's allowing the Variation and the Distance

H.	K.	F.	Courses	Winds.	Leeway.	Remarks on board, Wednesday, June [illegible], 18[illegible]6.
2	6	2	S. S. W.	N. N. E.		Light Breezes and clear. Variation per amplitude 18° 30′ W.
4	3		S. S. W. ¼ W.			
6	2					
8	2					
10	2					
12			Calm.			Made and shortened sail occasionally.
2	4	4	S. S. W. ¼ W.	W. N. W.		
4	5	4				
6	6					
8	6	3				
10	5	6		N. W.		Fresh breezes and clear. Set studding sails. Lat. by obs. 30° 31 N.
12	4					

Course.	Dist.	Diff. Lat	Dep.	Lat by D. R.	Lat. by Obs	Mer. Diff	Diff. Lon.	Long. in.	Bearing and Distance.
S. 1° 30′ E.	111	111	E. 2.5	30.31 N	30.31 N	E. 2 5	3 mi. E.	16° 33 W.	Salvages, [illegible] Distance 42 miles.

Courses corrected.	Dist.	N.	S.	E.	W.
S 55° E.	23		18.8	13.2	
S. 4. W	12		12.0		0,8
S. 7 W	81		80.4		9,9
			111.2	13.2	10,7
				107	
				25	

Lat. Depar. 32 22 N. M P 20[illegible]4
✕ Lat. 1 15 S.

Lat. in. 30 31 N. M P 1924

Sum 2)62 53 M ✕ Lat. 130

Mid. Lat. 37 28
Lat. Sal. 30° 8 N M P 1898 Long. 15° 53 W.
Lat. in. 30 31 N M P 1924 Long. 16 33

✕ Lat. 23 M P 26 ✕ Long. 40

With the M. diff. lat. and diff. of long. the Salvage bears as above.

H.	K.	F.	Courses.	Winds.	Leeway.	Remarks on Thursday, June [illegible], [illegible]806
2	6	4	South	West.		Fresh Breeze and clear, all sails set.
4	6	2				
6	5	0				Var. 18° W.
8	4	2				
10	6	3				
12	5	4				
2	5		S. by W.	W. by W.		Do. Weather, two sails in sight.
4	5					
6	3					
8	3					
10	2	4				Light Breezes
10	2	1		W. by S.		In studding sails.

Course.	Dist.	✕ Lat.	Dep.	Lat. by Acc.	Lat. by Obs.	M. Dist.	✕ Long.	Long. in.	Bearings and Dis.
S. 14° E.	1[illegible]7	S. 104	E. 26	N. 28 47	N. 28 47	E. 29	E. 2[illegible]	W. 16 4	[illegible] Cru. Teneriffe S 2[illegible]° 33 W. 22 M.

Courses corrected.	Dist.	N.	S.	E.	W
S. 18° E.	67		63.7	2[illegible].7	
S. 7 E.	4[illegible]		4[illegible].7	5.0	
			1[illegible]4.4	2[illegible]7	

Lat. lft. 30 31 N M P 19 24 Lon. St. Cru. 16 16 W
✕ Lat. 144 S

Lat. in. 28 47 M P 1805 Long. in. 16 4 W

2)59 18 119 Diff. Long. 12

M. Lat. 29 39 Lat. S. Cru. 28° 27 N. M. P. 1782
Lat. in. 28 47 N. M. P. 18[illegible]5
C. M. L. 60 21
Diff. of Lat. 20 M. ✕ lat. 23

With the Mer. Diff. of Lat. and Diff. of Long. by Mercator the Bay of Santa *Cruz, in Teneriffe*, bears as above.

H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on board, Friday, June 6, 1806.
2	3	4	S. S. E.	S. W.	1	Fresh breeze and cloudy.
4	3					
6	2	4				Handed top-gallant sails, and in first reef
8	3					top-sails. At 6, the Peak of Teneriffe
10	3					bore by compass W. S. W.
12	2	4	W. N. W.	Ditto.	1	Fresh breezes and clear. Variation 18° W.
2	2	4				
4	2					Set top-gallant sails. Hazy with rain. No
6	2					land in sight.
8	3					Light breezes and clear.
10	2	4	S. S. E.	Ditto,	1	At noon made Teneriffe, bearing W. by
12	2	4				N. dist. 6 or 7 leagues.

Course.	Dist.	Dif. lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Mer. Dist.	Dif. of Long.	Long. in.	Bearing and dist.
S. 25° E.	20	S. 18	E. 8	N. 28 30		37E.	10m.E.	15 54 W.	S. Cruz, Teneriffe, S.82°14W.D20M.

The courses being corrected for one point leeway, and 18° W. variation all these 24 hours, I find by the Traverse Table the direct course of the ship to be S. 25° E. dist. 20 miles.

Courses corrected.	Dist.	N.	S.	E.	W.
S. 52° E.	30		18 5	23 6	
N. 74 W.	24	6 6			23 . 1
S. 52 E.	10		6 2	7 9	
		6 6	24 7	31 5	23 . 1
			6 6	23 1	
	Dif. lat.		18 1	8 . 4	Dep.

Dif. of lat.	0° 18 S.	
Lat. left	28 47 N.	
Lat. in	28 29 N.	
Sum lat.	57 16	
Mid. lat.	28 38	
Com. mid. lat.	61 22	

With the comp. of mid. lat. the diff. of long. is found to be 10 miles; and the bearing and distance of Santa Cruz by mid. lat. is found to be S. 82° 14′ W. dist. 20 miles.

H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on board, Saturday, June 7, 1806.
2	3		W. by N.	N N. E.		Light breezes and clear. Made all sail.
4	3					
6	3					At 5 the east end of Teneriffe N.W. 4
8						miles; at 7 anchored in 9 fathom
10						in Santa Cruz Road, the town of
12				Variable.		Santa Cruz W. by N. ½ a mile.
2						Variation 17° 30′ west.
4				West.		At 8 A. M. hoisted out the boats and
6						went on shore to wait on the Gov.
8						Moored ship with the small bower to
10				Calm.		the S.W. in 19 fathom, and stream
12				South.		anchor to the N. E. in 10 fathom.

Course.	Dist.	Dif. lat.	Dep.	Lat. by D.R.	Lat. by Obs.	Mer. Dist.	Diff. Long.	Long. in.	Bearing and dist.
S. 82° W.	10	S. 3	W. 19	28.27N		18 E	21mW.	16° 15W.	At anchor in San. CruzRd, Tenerif.

The Courses being corrected for 17° 30′ W. variation, I find by the Traverse Table the true course to be S. 82° W. dist. 19 miles.

Course corrected.	Dist.	N.	S.	E.	W.
S. 82° W.	19		25		18 8
	Diff. lat.		25	Dep.	18.8

Dif. lat.	0° 3 S.
Lat. left	28 30 N.
Latitude	28 27
Com. mid. lat.	61 32

With the com. of mid. lat. the diff. of long. is 21 miles.

An Abstract of the foregoing Journal.

Day. Week.	Month. May	Course.	Dist.	Lat. by Ac.	Lat. by Obs.	Long. in.	Bearings of Funchal.	Dist. Miles.
♂	6	S. 26°33′W.	107	48 21N.		6 26W	S. 24° W.	1148
☿	7	S. 30° W.	108	46 48N.		7 45W	S. 26° 44′W	952
♃	8	S. 8° 30′ W.	97	45 12	45 23 N.	8 6	S. 28 34	871
♀	9	S. 4° E.	76	44 8		7 49	S. 32 10	815
♄	10	S. 79° W.	20	44 4		8 20	S. 30 53	799
☉	11	S. 80° W.	84	43 49	43 34	10 2	S. 26 49	735
☽	12	S. 53°30′W.	84	42 44		11 35	S. 23 15	655
♂	13	West.	120	42 44	42 30	14 15	S. 12 48 W	607
☿	14	South.	170	39 46	39 40	14 15	S. 17 59 W	444
♃	15	S. b W. ½ W.	192	36 49	36 36	15 26	S. 18 51 W	252
♀	16	S. 68° W.	119	35 52	35 46	17 39	S. 8 29 W	190
♄	17	S. 35° 20′E.	135	34 01	33 56	16 6	S. 32 7 W	92
☉	18	Anchored in Funchal road, and failed 3d June for Teneriffe.						
							Desertors. N.W. ¼ N.	23
♂	3			32 10			Salvages.	
☿	4	S. 1° 30′ E.	111	30 31	30 31	16 33	S. 56 58 E.	42
							Santa Cruz	
♃	5	S. 14 E.	107	28 47	28 47	16 4	S. 27 33 W.	22
♀	6	S. 25 E.	20	28 30		15 54	S. 82 14 W.	20
♄	7	S. 82 W.	19	Anchor in Santa Cruz road, ½ mile off shore.				

The Method of finding the LATITUDE *at* SEA, *by taking two Altitudes, either in the Forenoon or Afternoon, leaving the intermediate Time measured by a common Watch, with Ease and Accuracy, independent of the Sun's Meridian Altitude.*

GENERAL RULES.

1st. TO the secant of the latitude by account, add the secant of the sun's declination, (rejecting their indexes) and call that sum the logarithm ratio*.

2d. From the natural sine of the greatest altitude, subtract the natural sine of the least altitude, and find the logarithm of their difference, and write it under the logarithm ratio,

* The arithmetical comp. of the co-sine of any angle is equal to the logarithmic secant of that angle, omitting the first figure in the index; thus the secant of 46 deg. 50 min is 10.16487, and omitting the first figure 1, leaves 0,16487, the secant less radius, or the arithmet. comp. of co-sine 46 deg. 50 min.

3d. Subtract the hours and minutes when the altitudes were taken from each other, and half the difference call half-elapſed time.

4th. With half the elapſed time enter the tables, and from the column of half-elapſed time take out the logarithm anſwering thereto, and ſet it down under the logarithm ratio.

5th. Add theſe three logarithms together, and with their ſum enter the tables in the column of middle time, where, having found the logarithm neareſt thereto, take out the time correſponding to it, and put it down under half the elapſed time.

6th. Subtract the leſs from the greater, and the difference will be the time from noon, when the greateſt altitude was taken.

7th. With this time enter the tables, and from the column of riſing, take out the logarithm correſponding to it; from this logarithm ſubtract the logarithm ratio, the remainder will be the logarithm of a natural number which, being found in a common table of logarithms, and added to the natural ſine of the greateſt altitude, will give the natural ſine of the ſun's meridian altitude.

Having the meridian altitude of the ſun at noon, the latitude is found by the uſual method.

N. B. If the latitude, found by the above proceſs, ſhould differ widely from the latitude by account, it will be proper to repeat the operation, uſing the latitude laſt found inſtead of the latitude by account, till the reſult gives a latitude nearly agreeing with the latitude uſed in the computation.

EXAMPLE. I.

Being at ſea in latitude 46° 50′ north by account, when the ſun's declination was 11° 17′ N. at 10 H. 2 M. in the forenoon, the ſun's altitude was 46° 55′, and at 11 H. 27 M. in the forenoon, the ſecond altitude was 54° 9′. Required the true latitude, and true time of the day when the greateſt altitude was taken?

H. M.	Nat. Sines Lat. 46° 50′ Sec.	0,16487
11 27 0	Gr. Alt. 54° 9′—81055 Dec. 11° 17′ Sec.	0,00848
10 2 0	lea Alt. 49° 55′—73036 Log Ratio	0,17335
Ela. T. 1 25 0	80.9 Com. Log.	3,90412
½ Ela. T. 42 30	in the column of ½ elapſed Time	0,73429
1 15 30	in the column of middle Time	4,81176
T. f. noon 33 0	in the column of Log riſing	3,01488
From which ſubtract the Log ratio		0,17335
The natural Number in the Logarithms = 694		2,84153
to which the nat. ſine of the greateſt Alt. 81055		90 00
gives the nat. ſine of the Sun's mer. Alt. = 81749		54 50
		35 10

	Sun's Zenith Diſtance	35 10 N
	Sun's Declination	11 17
	Latitude	46 27 N
H. M.		
12 0	The obſervation at Noon was	46 28 N
11 27		

33 as the time agrees with the obſervation, the watch is right.

EXAMPLE II.

Being at ſea in lat. 47° 19′ N. by account, when the ſun's declination was 12° 16′ N. at 10 H. 24 M. A. M. per watch, the ſun's alt. was 49° 9′ at 1 H. 14 M. P. M. his alt. was 51° 59′. Required the latitude?

	H. M. S.				
	12 0 0				
	10 24 0				
		Alt.	Nat. S.	Lat. 47° 19′	0,16880
	1 36 0	49° 9′	75642	Sun's decl. 12 16	0,01003
	1 14 0	51 59	78783		
				Log. ratio	17883
Ela. T.	2 50 0	Diff. N.S. 3141		Its log.	3,49707
½ El. T.	1 25 0	Its log. in col. of half elapſ. time is			0,44077
Sub.	0 15 0	Col. of mid. time correſponding to			4,11667
Tr. Ti	1 10 0	Its log. in col. of riſing is		—	3,66542
Ti. p. W.	1 14 0	Log. ratio ſub.		—	0,17883
Wat. faſt	0 4 0	3066 the nat. num. of this log.			3,48659
N. S. Sun's gr. alt.		78783	90 00		
N. S. S. mer. alt.		81849 =	54 56		
	Sun's zen. diſt	—	35 4 South		
	Sun's decl.	—	12 16 North		
	Lat. in	——	47 20 North.		

Here the Latitude found by computation may be relied on, as it differs but one mile from that uſed in the operation.

EXAMPLE III.

Being at ſea in lat. 50° 40′ North per account, when the ſun's declination was 20° 0′ South, at 10 H. 17 M. A. M. per watch, the ſun's alt. was found 17° 13′, at 11 H. 17 M. A. M. per watch, it was found 19° 41′. Required the latitude?

Times

	Times			Alt. Nat. S.		
	H.	M.	S.		Lat. 50° 40′	0,19803
					Decl. 20 00	0,02701
	10	17	0	17° 13′=29599		
	11	17	0	19 41=33682	Log. ratio	0,22504
El. T.	1	0	0	Diff. N. S. 4083	Its com. log.	3,61098
½ El. T.	0	30	0	Its log. from col. half elap. time is		0,88430
	1	1	0	In col. of mid. time corresponding to		4,72032
Tr. time	0	31	0	From noon, its log. from col of rising		2,96067
T. p. W.	0	43	0		log. ratio sub.	0,22504
W. slow	0	12	0	544 N. num. of		2,73563
				33682 N. S. greatest alt.		
	90°	0′		34226 N. S. the sun's mer. alt. 20° 1′.		
	20	1				
Zen. dist.	69	59				
Decl.	20	0	S.			
Lat.	49	59	N.			

But as this latitude differs 41 miles from that by account, it will be proper to repeat the operation, using the lat. last found instead of the lat. by account.

	H.	M.	S.			
½ Elapsed time	0	30	0	Lat.	49° 59′	0,19178
	1	0	0	Decl.	20 0	0,02701
				Log. ratio		0,21879
True time	0	30	0			3,61098
Time per watch	0	43	0			0,88430
					H. M.	
Watch slow	0	13	0	In col. mid. T.	1 0	4,71407
True time	0	30	0	Its log. in col. of rising is		2,93223
					Log. ratio	0,21879
				517 Nat. num. of		2,71344
				33682 Nat. S. gr. alt.		

Nat. S. sun's mer. alt. 34199=20° 0′

Zen. dist.	70	0
Declin.	20	0 S.
The lat.	50	0 North.

The latitude last found, differing only one mile from that used in the operation, may be depended on as the true latitude. Hence it is plain, that the operation is repeated with very little additional trouble, few alterations being necessary.

EXAMPLE IV.

Being at ſea in latitude 60° 0′ north by account, when the ſun was on the equator, and conſequently had no declination at 1 H. 0 M. P. M. per watch, his altitude was 28° 53′, and at 3 H. 0 M. P. M. per watch, it was 20° 42′. Required the true latitude?

	Times.					
	H.	M.	S.	Alt.	N. S.	Lat. 60° 0′=0,30103
						Dec. 0 0 =0,00000
	1	0	0	28 53	=48303	
	3	0	0	20 42	=35347	Log. ratio 0,30103
Elap. T.	2	0	0		12956	Its log. 4,11247
½ El. T.	1	0	0	Its log. in col. of ½ Elap. time.		0,58700
	2	0	0	Its log. in col. of mid. time		5,00050
T. fr. N.	1	0	0	Its log. from col. of riſing		3,53243
D.perW.	1	0	0			Log. ratio 0,30103
				1704	N. num.	3,23140
				48303		

Nat. S. Sun's mer. alt. 50007=30 0 Sun's merid. alt. (90° 0′ − 30 0)

60 0 Latitude

The latitude by computation, coming the ſame with the latitude by account, ſhews that the latitude by account was right. From the foregoing examples it is plain, that the operation is the ſame, whether the ſun hath north or ſouth declination. And it will be the ſame whether the ſhip is in a north or ſouth latitude. It is alſo clear, that when the ſun has no declination, the ſecant, rejecting the index of the latitude is the log. ratio.

EXAMPLE. V.

Wanting to go through the N. Channel among the Maldives, and by account being in latitude 7° 40′ N. the declination being then 22° 47′ N. at 7H. 25M. 40 S. A.M. the true altitude of the ſun's centre was 22° 30′, and at 10 H. 31 M. 48. S. A. M. it was found 63° 40′. Required the ſhip's true latitude?

	H.	M.	S.	Alt.	Nat. S.		
						Lat by ac. 7°40′	0,00390
Times	10	31	48	63° 40′	89623	Declin. 22 47	0,03528
	7	25	40	22 30	38268		
						Log. ratio.	0,03918
Elap. T.	3	6	8		51355	Its log.	4,71058
½ El. T.	1	33	04	Its log. in col. of ½ elap. time is			0,40368
						H. M. S.	
	3	1	30			3 1 30	5,15344
True T.	1	28	26	Its log. in col. of riſing is			3,86709
T. p. W.	1	28	12			Log. ratio	0,03918
W. ſlow	0	0	14		6728	Nat. num.	3,82791
				90 00	89623	——— N. S gr. alt.	
Mer. alt.				74.29			
					96355	N. S. Sun's mer. alt.=74° 29′.	

Zen. dist. 15 31 N.
Decl. 22 47 N.

Lat. in 7 16 North.

N. B. As the Tables are only calculated to 10 seconds, the log. for any intermediate second is found by taking the difference between the log. next greater and next less; and saying, as 10 seconds is to that difference, so is the given seconds to the difference of the logarithms; or, if it be any even part, take such a part of the difference, and apply it to the next less logarithm; but in these operations a few seconds are not regarded.

Second Operation.

	Lat.	7° 16′	0,00350
	Dec.	22 47	0,03528
	Log. ratio		0,03878
H. M. S.			4,71058
3 1 20			0,40368
1 33 4		H. M. S.	
		3 1 20	5,15304
True time 1 28 26			
			3,86709
N. S. gr. alt. — 89623	Log. ratio		0,03878
6735 N. num.			
	Log.		3,82831

N. S. Sun's m. alt. 96358 = 74 29. Hence the lat. in is 7°16′N.

The latitude last found, agreeing with that used in the operation, it may be taken as the true latitude; and the operation is repeated with very little additional trouble, few alterations being necessary. Hence it is plain, that if you are mistaken in the latitude by account, yet by repeating the work two or three times, making use of the latitude last found in the next operation, it will at last discover itself to be true, by being equal to the last supposition, which evidently shews the excellency of these Tables.

In the former examples we have considered both altitudes taken at the same place or station; but as that is seldom the case at sea, the necessary correction for any alteration of station may be readily made as follows:

	H.	M.
Suppose the first altitude in the forenoon, at	10	26
The second altitude in the afternoon, at 2h. 43 m.	14	43
Difference of longitude made is 30 miles W. equal to	0	2
	14	41
	10	26
Subtracted is the elapsed time — —	4	15

If a ship has been sailing to the Eastward, the above two minutes must be added; but unless the difference of longitude be considerable, it is not worth notice, as it will make a very inconsiderable error in the latitude.

Again,

Again, if the ship sails or makes towards that point of the compass which the sun bears upon, she must raise the sun's altitude as many minutes as the miles she has run towards it; therefore the miles run towards the sun must be added to the first altitude; but if sailing from the sun, the same must be subtracted; if they are but few, they are not worth minding: and then the seaman may make a very good estimation by looking at the log-board only, who by that will be able to ascertain the distance sailed to, or from the sun, between the observations, which will be of sufficient exactness in the practice of navigation; and if the ship makes an angle with the sun's bearing, it may be readily found by the Table of Difference of Latitude and Departure, and then either add or subtract, according as the case requires; as may be seen in the following examples, which are inserted for the benefit of those who require a greater degree of accuracy.

EXAMPLE VI.

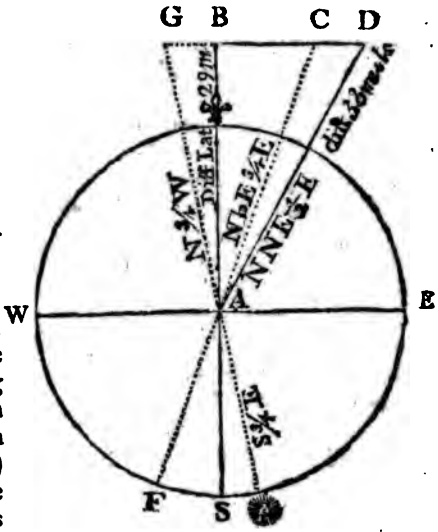
Suppose a ship from the Bay of Biscay, bound to the English Channel, in a brisk gale running N. by E. $\frac{1}{4}$ E. per compass, at the rate of nine knots per hour, at 10 H. 0 M. A.M. per watch; observed the sun's altitude 13° 18′ bearing S. $\frac{3}{4}$ E. by compass, and at 1 H. 40 M. P. M. per watch, the sun's altitude again was found 14 15, the latitude by account being 49° 17′N. and the sun's declination 23° 28′ S. Required the true latitude?

Correction of the first Altitude.

The time of the first observation is 10 H. 0 M. A. M. and of the second 1 H. 40 M. P. M. the elapsed time is 3 H. 40 M. and the rate of sailing is 9 miles per hour; then say, by the Rule of Three, as 1 H. is to nine miles, so is 3 H. 40 M. to 33 miles, the distance run in the elapsed time.

Again, the sun's bearing at the first observation is south $\frac{3}{4}$ E. the opposite to which is N. $\frac{3}{4}$ W. or $\frac{3}{4}$ point, and the ship's course during the elap. time is N. by E. $\frac{1}{4}$ E. $1\frac{1}{4}$ points, so the angle of ship's course with the sun's bearing is $2\frac{1}{2}$ points.

Now in the Table of Difference of Latitude and Departure, to the course $2\frac{1}{2}$ points, and distance 33, the difference of latitude is 29 miles, the ship sails from the sun: therefore from the first observed altitude 13° 18′ take 29′, the remainder 12° 49′, is the first altitude corrected, which is to be used in the operation, as follows:



Let the circle represent the compafs N, S, E, W, and A the ſhip's place. Take the ſhip's courſe N, by E. ¾ E. or 1 ¾ point, and ſet it off from the north towards the eaſt; take the ſun's bearing S. ¾ E. or ¾ of a point, and ſet it off from the ſouth towards the eaſt; the oppoſite point is A G, N. ¾ W. then will G A C be the angle the ſhip has made during the elapſed time, which angle being ſet off from the north, (or meridian) to the eaſt, will be the true courſe the ſhip has made from the ſun, as the angle BAD. From A to D ſet off 33 miles, the diſtance ſailed in the elapſed time; from D draw a line parallel to the E. and W. to cut the north or meridian line at B, then AB will be the difference of latitude 29 miles, that the ſhip has ſailed from the ſun during the elapſed time.

	H. M. S.	Alt.	Nat. S.	Lat. 49° 17′	0,18554
Times	10 0 0	12° 49′=22183		Decl. 23 28	0,03749
	1 40 0	14 15=24165			
				Log. ratio	0,22303
Ela. T.	3 40 0	Diff. N. S.	2432	Its log.	3,38596
				Its log.	0,33559
½Ela. T.	1 50 0				
	0 10 0	Time correſponding to			3,94458
	1 40 0	Its log. in col of riſing is			3,97170
		Log. ratio	—	—	0,22303
	90 0		5606	Nat. num. of	3,74867
	17 35		24615		

Zen. diſt. 72 25 N. S. M. Alt. 30221=17 35 ☉'s mer. alt.
Declination 23 28

Latitude 48 57 N.

But as the latitude by computation differs conſiderably from that by account, the work muſt be repeated.

Latitude	48° 57′=0,18262	
Declination	23 28	0,03749
	Log. ratio	0,22011

				Log. ratio		0,22011
		H. M. S.		Diff. N. S. 2432	Its log.	3,38596
		1 50 0			Its log.	0,33559
		0 10 0		Time anſwering to		3,94166
	90 0	1 40 0		Its log. in col. of riſing		3,97170
	17 37			Log. ratio		0,22011
Zen. diſt.	72 23 S.		5644	Nat. num. of		3,75159
Declina.	23 28 S.		24615			
Tr. lat.	48 55 N.		30259	N. S. mer. alt. 17° 37′.		

This latitude differing only two miles from that in the above computation, it may be depended upon as the true latitude.

EXAMPLE VII.

A ſhip ſailing N E. half E. by compaſs, at the rate of nine knots an hour, at 0 H. 31 M. 40 S. P. M. per watch, I found the altitude of the ſun's lower limb 28° 20′ above the horizon of the ſea, the eye being elevated twenty feet above the ſurface of the water, and the ſun's bearing by compaſs being at the ſame time S. by W. and at 2 H. 58 M. 20 S. P. M. by watch, the altitude of the ſun's lower limb was 16° 41′ above the horizon, the eye being elevated as before, and the latitude by account, at the time of the laſt obſervation, was 48° 5′ north, and the declination 13° 17′ ſouth. Required the true latitude at taking the laſt obſervation?

Firſt obſerved alt. ſun's lower limb	28°	20′	Second ditto 16°	41′
Refraction to be ſubtracted		2		3
Correction for refraction	28	18	16	38
Dip of the horizon ſubtracted		4		4
App. alt.	28	14	16	34
Sun's ſemidiameter added	0	16	0	16
Correct altitude of ſun's centre	28	30	16	50

Correction for the firſt Altitude.

The time of the firſt obſervation 0 H. 31 M. 40 S. P. M. of the ſecond 2 H. 58 M. 20 S. P. M. ſo the elapſed time is 2. H. 26 M. 40 S: the rate of ſailing is nine miles per hour. Then as 1 H. : 9 miles : : 2 H. 26 M. 40 S. : 22 miles, the diſtance run in the elapſed time.

Again, the ſun's bearing at the firſt obſervation is S. by W. the oppoſite point to which is N. by E. or 1 point.

The ſhip's courſe during the ela. time is N. E. ½ E. or 4½ pts.

So the angle of the ſhip's courſe with the ſun's bearing is } 3 ½ pts.

In

In the table of difference of latitude and departure, to the courſe $3\frac{1}{4}$ points, and diſtance 22 miles, the difference of latitude is 17 miles, which the ſhip ſails from the ſun.

Wherefore, firſt obſerved altitude $28° 30' - 17' = 28° 13'$ the firſt correct altitude to be uſed in the operation.

	H. M. S.	Alt.	N.S.		
				Lat. by ac. 48° 5′	0,17519
Times	0 31 40	28° 13′	47281	Declin. 13 17	0,01178
	2 58 20	16 50	28959		
				Log. ratio	0,18697
Ela. T.	2 26 40	Diff. N.S.	18322	Its log.	4,26297
½ Ela. T.	1 13 20	Its log. from col. of ½ elapſ. time.			0,50232
	1 46 27	In col. of mid. time correſponding to			4,95226
	0 33 7	Its log. from col. of riſing			3,01794
				Log. ratio.	0,18697
		N.S. gr. alt.	47281		
	90 0		678	N. numb. of	2,83097
Mer. alt.	28 40	N. S.	47959		
Zen. diſt.	61 20				
Decl.	13 17				
Lat.	48 3 N.				

And as it differs but two miles from the latitude by account, it may be taken as the true latitude.

Queſtions for Exerciſe.

1ſt. Being at ſea in latitude by account 39° 28′N. when the ſun's declination was 20° 41′ N at 11 H. 30 M. 15 S. A. M. per watch, the altitude of the ſun's lower limb was obſerved to be 68° 18′ 45″, and at 12 H. 26 M. 28 S. P. M. it was 70° 58′, the height of the eye being 21 feet above the ſurface of the ſea. Required the true latitude of the ſhip? Anſwer, 39° 28′ N.

2d. Being at ſea, in lat. 50° 4′ N. by account, at 10 H. 17 M. 30 S A.M. per watch, the altitude of the ſun's lower limb was obſerved to be 17° 4′ ¼, and at 11 H. 17 M. 30 S. it was 19° 31′, the declination being then 20° S. and the height of the eye 21 feet above the ſea. Required the latitude in? Anſwer 50° 2′ N.

3d. Suppoſe a ſhip at ſea in lat. 47° 17′ N. by account, at 9 H. 55 M. 30 S. by watch, the altitude of the ſun's lower limb was 17° 24′, bearing by compaſs S. by E. ¼ E. and at 12 H. 54 M. 10 S. his altitude was 21° 45′ ½, the declin. being then 19° 30′ S. the height of the eye 20 feet above the ſea, and the ſhip's courſe by compaſs was E. ½ S, at the rate of 7 knots per hour. What was the latitude? Anſwer 47° 23′ N.

4th. At 11 H. 28 M. 20 S. A. M. per watch, the altitude of the ſun's lower limb was 28° 18′, the ſun bearing then S. by W. by compaſs.

compaſs. At 2 H. 58 M. 20 S.P.M. his altitude was 16° 40′, the height of the eye 20 feet, his declination being then 13° 17′ S. and the latitude then by account 48° 08′ N. the ſhip's courſe during the elapſed time was N.E. with her larboard tacks on board ſailing at the rate of ſix knots, and made half a point lee-way. What latitude was ſhe in when the laſt altitude was taken? Anſwer 48° 9′ N.

By the ſhip's courſe per compaſs is to be underſtood its courſe made good; lee-way, if any, being firſt allowed; or the courſe, by compaſs, corrected for the lee-way only, but not for the variation. Had the variation of the compaſs been applied, both to the ſhip's courſe and the ſun's bearing, it would not have made any difference in the operation or reſult, as the angle formed by them will always be the ſame, whether they are both eſtimated by the compaſs, or when the variation is allowed on both.

This method of finding the latitude is of excellent uſe, ſince there are ſo many circumſtances at ſea, which deny the opportunity of having the ſun's meridian altitude; and as the knowing the true latitude is of the greateſt conſequence, eſpecially in coming into the Engliſh channel, &c. where there are frequent obſtructions of clouds, every ſeaman ought to be ready at determining his latitude, by this method, whenever an opportunity offers, leſt he ſhould not ſee the ſun upon the meridian.

NOTE. The nearer to noon the obſervations are taken the better; provided the elapſed time be not much leſs than half the interval of time, when they are both taken on the ſame ſide of noon, nor much greater than once and half the greater interval, when taken on different ſides of noon.

To find the LATITUDE *by one* ALTITUDE *of the Sun, when the Time is not more diſtant than one Hour from Noon.*

RULE.

To find the true Time.

WHEN the ſun's declination and complement of the latitude are both north or both ſouth, their ſum, but if one be north and the other ſouth, their difference, is the meridian altitude.

From the natural ſine of the ſun's meridian altitude, ſubtract the natural ſine of the obſerved altitude.

Then add together,

The log. co-ſecant of the comp. of the lat. } reject their indexes,
The log ſecant of the ſun's declination, }

and the common logarithm of the difference of natural ſines into one ſum. The ſum of theſe three logarithms being found in the column of riſing, the hours, minutes, and ſeconds correſponding to it, will be the true time from noon when the altitude was taken.

EXAMPLE.

Being at ſea in latitude 50° 4′ N. by account when the ſun's declination

clination was 20° south, at 11 H. 17 M. A. M. per watch, sun's alt. was 19° 41'. Required the true time?

Comp. lat.	39. 56 N.	Co-sec.	0.19254
Declination	20. 00 S.	Sec.	0.02701
Sup. m. alt.	19. 56 Nat. sine 34120		
		L. ra.	0.21955
Obser. alt.	19. 41 Nat. sine 33656		
	464	Co.L.	2.66652

		H. M. S.
		12. 00. 00
Log in col. of rising	2.88607 is =	00. 28. 25
	True time at sea	11. 31. 35

Having the true time previous to the observation, to find the change of altitude.

Add together the logarithm found in the col. of rising, answering to the minutes and seconds the sun had to rise when the altitude was taken, and the secant of the supposed meridian altitude from this sum, (the index being increased by 5*) subtract the log ratio, the remainder is the log. sine of the change of altitude from the time of observation to noon; which, being added to the observed altitude, gives the sun's meridian altitude.

Log. in col of rising of 28 M. 25S.	2.88607	Obser. alt.	19.41
Log. sec. m. alt. 19° 20' + 5 Index	5.02683	Cha. of alt. +	20
		Tr. m. alt.	20.01
	7.91290		
Subtract log. ratio	0.21955		
Log. sine chan. of alt. 20 min.	7.69395		

EXAMPLE.

Being at sea in lat. 60° north by account when the sun was on the equator, at 1 H. 0 M. P. M. per watch, the sun's alt. was 28° 53'. Required the true time and latitude in?

Com. lat. } Mer. alt. }	30 00 N.	Nat. sine 50000	C.sec. 0.30103† Log. ratio.
Ob. alt.	28.53	Nat. sine 48303	
Ch. of alt.	1.08	1697	Com log. 3.22968
			H. M.
T. m. alt.	30.01	Log. in col. of rising is =	3.53071 = 1.00 TrT
Zen. dist.	59.99 N.	Log sec. mer. alt. + 5 In.	5.06247

The S. being on the equator.

	8.59318
Subtract log. ratio	0.30103
Log sine chan. of alt. 1° 08'	8.29215

* The 5 is the index of six hours in the column of rising.

† The sun being on the equator, and having no declination, the co-sec. of the comp. of the lat. gives the log. ratio.

EXAMPLE III.

Being at sea in lat. 39° 28′ north by account, sun's declination 20° 41′ north at 26 M. 28 S.P.M. sun's alt. was 71° 10′. Required the true time and latitude at the ship?

Comp. lat.	50.32N.			Co.sec.	0.11239
Declination	20,41N.	Nat. sine	94674	Secant	0.02893
Sup. m. alt.	71.13	Nat. sine	94646		0.14132
			28	Com. log.	1.44716
					M. S.
Obser. alt.	71.10	Log. in col. of rising is			=1.58848=6 30 T.T.
Chan. alt.	3	Log. sec. sup. mer. alt. +			5.49216 [at sh.
T. mer. alt.	71.13				
Zen. dist.	18.47 S.				7.08064
Declination	20.41 N.	Subtract log. ratio			0.14132
Lat. in	39.28N.	L. sine chan. of alt. 3 m.			6.93932

NOTES.

1st. The altitudes for determining how much the watch differs from apparent time had better be taken in the morning, or evening, when the sun's altitude does not exceed 18 degrees.

2d. An error in the supposed latitude can make very small difference in the change of altitude; and the nearer the altitude is taken to noon the better to find the change of altitude.

3d. This method is not to be depended on should the apparent time exceed an hour from noon, and, in some instances, not then; such as altitudes taken near the equator; or when the meridian altitude exceeds 60 degrees; nor is there much occasion for this method, or that of the double altitudes there, since there is generally a clear horizon, and consequently a meridian altitude is easily obtained.

To find the Latitude by the Meridian Altitude of the Moon.

To the Longitude of the given place in time add the number from (T. XVII.) corresponding to that Longitude, and the daily variation of the moon's passage over the meridian on the given day, (Nau. Alm. p. vi.) if the Longitude be west; but subtract the sum if the Longitude be east: the sum or difference will be the time at Greenwich when the moon was on the meridian of the given place.

In page 7th of the month in the Almanack, find the moon's semi-diameter, and horizontal parallax, at the nearest noon, or midnight, to the reduced time, which will be sufficiently accurate for the purpose of finding the latitude. For Parallax, see the use of the sextant.

Take the difference between the moon's semidiameter and dip, and add it to the observed altitude, if the lower limb was observed, but subtract their sum if the upper limb was observed; the sum or difference will be the apparent altitude of her centre.

From the proportional logarithm of the moon's horizontal parallax, increasing its index by 10, subtract the log. co-sine of the

the moon's apparent alt. the remainder will be the prop. log. of the moon's parallax in altitude, from which take her refraction, the difference will be a correction, which, being added to the apparent altitude, will give the true altitude of her centre: hence the zenith distance, to which apply her declination, and you will have the latitude.

NOTE. The moon's declination is set down in page the 6th of the month for every noon and midnight in the Nautical Almanack.

Therefore find the declination for the nearest noon and midnight, both before and after the reduced time, and take the difference.

From (T. XVIII.) take out the number corresponding to the hours at top, and the minutes in the left hand column, with the time at Greenwich, with which multiply the difference; from the product cut off four figures from the right hand, the remainder is a correction to be added to the declination, if increasing, but subtracted if decreasing; the result will be the declination at the given time.

EXAMPLE I.

Suppose, on Oct. 1, 1806, in longitude 45° W. the altitude of the moon's lower limb, when on the meridian, south of the observer, should be 60° 43′ 0″, the eye being 23 feet above the sea. Required the latitude?

The longitude 45° west turned into time equal to 3 hours, and the correction 7 M. from (T. XVII.) added to 15 H. 13 M. the time the moon passes over the meridian on the given day, gives 18 H. 40 M. time at Greenwich.

Hor. par.	57′ 10″ P. L.	10,4981	Moon's ob. alt.		60° 43′ 0″
App. alt.	60 54 L. co-si	9,6869	M. sem. dia.	15 35	+ 11 1
			Dip	— 4 34	
Par. in alt. =	27 48 P. L.	8112			60 54 1
Refrac.	— 23				
	27 25		Cor. of the moon's alt.	+	27 25
Moon's dec. midnight		21° 31′ N.	True alt.		61 21 26
Do. at noon		22 24 N.	Dec. 21° 31′		90
Diff. in 12 hours		53 +		Zen. dist.	28 38 34 S
Then 53 × by ,5278 (T. XVIII.) gives				+ 28	
Moon's dec. at reduced time				21 59	21 59 N
				Latitude	50 37 34 N

EXAMPLE II.

Suppose, on Dec. 27, 1806, in longitude 60° *east*, the altitude of the moon's *upper* limb should be observed, when on the meridian, being then south, 54° 30′; the eye 20 feet above the sea. Required the latitude?

The

The longitude 60° east in time equal to 4 hours, less the correction 9 M. found in (T. XVII.) subtracted from 14 H. 18 M. the time the moon passes over the meridian on the given day, leaves 10 H. 27 M. time at Greenwich?

Hor. par.	60′ 28″ P.L.	10,4738	Moon's ob. alt.		54° 30′ 0″
App. alt. 54° 9	0 co-si.	9,7676	M. sem. dia. 16′ 29″		
		———	Dip 4 16		− 2045
Par. in alt.	36 25 P.L.	7062			———
Refraction −	41				54 9 15
	35 44	Moon's cor. to be added		+	35 44
					———
Moon's dec. at noon	16° 37′ N.		16° 37′ 0″ N.		54 44 59
Do. at midnight	14 26 N.				90
	———				———
	2 11		Zen. dist.		35 15 1S
2′ 11″ = 131″ × by 8708					
gives 114″ = 1′ 54″ (T. XVIII.)			− 1 54		16 35 6N
			———		———
Moon's dec. at reduced time			16 35 6N.	Lat.	51 50 7N

To find the Latitude by the Meridian Altitude of a Planet.

In page 4th of the month in the Nautical Almanack, are given the declinations and times of the planet's passage over the meridian of Greenwich every six days.

Reduce the longitude into time, and add it to, or subtract it from, the times of their passage over the meridian of Greenwich, according as the longitude is east or west: the sum or difference will be the time they pass the meridian of the place of observation: correct the observed altitude for the dip and refraction, with this corrected altitude and declination find the latitude.

EXAMPLE I.

Suppose, in longitude 15° West, on Oct. 7, 1806, the meridian altitude of Jupiter, when South of the observer, should be 29° 12′, the eye being elevated 22 feet above the surface of the sea, and the latitude be required?

By the Nautical Almanack, Jupiter passes the meridian of Greenwich that day at 5 h. 14 m. afternoon; and 1 h. the longitude in time added to it, gives 6 h. 14 m. the time of his passage over the meridian of the place of observation.

Mer. alt.	29° 12′ 00″
Dip 4′ 28″ + Refra. 1′ 41″	00 6 9
	———
	29 5 51
	90 00 00
	———
Zen. dist.	60 54 9 S.
Decl.	23 32 00 S.
	———
Lat.	37 22 9 N.

EXAMPLE II.

Suppose, in lat. by account, 47° 12′ N. and lon. 15° W. bound for the English Channel, and having had no observation for several days, I find the meridian altitude of Venus, bearing south of me, is 18° 15′, the eye being elevated 22 feet above the horizon, and the declination 23° 51′ 00″ S. Required the latitude?

Mer. alt.	18° 15′ 00″
Dip 4′ 28″ + Refra. 2′ 54″ —	00 7 22
True alt.	18 7 38
	90 0 0
Zen. dist.	71 52 22 S.
Decl.	23 51 00 S.
Lat.	48 1 22 N.

A COMPENDIUM OF NAUTICAL ASTRONOMY.

IT is a complaint frequently made by seamen, that it is a thing impracticable to find and know the stars. Recurring to the existing Treatises on the subject of Nautical Astronomy, the complaint does not seem altogether ill-founded, if we consider that seamen have but little time to acquire those sciences which are necessary for the understanding a regular system of astronomy. It has, therefore, been attempted to simplify and render practicable, the method of finding and knowing the stars. For the attainment of which purpose, we beg leave to introduce the following methods:—

RULE.

Look for the right ascension of the sun and star in Tables XIV. and XV. and subtract the sun's right ascension from the star's; but if the sun's right ascension be greatest, add 24 hours to the star's right ascension, and then subtract the sun's from it, the remainder will be the time of the star's coming to the meridian.

When the sun's right ascension is least, the star comes to the meridian in the afternoon: but before noon, when the sun's is the greatest.

EXAMPLE

Example I.

At what time will the ſtar Arcturus be on the meridian of Greenwich, Dec. 1, 1806?

	H.	M.	S.
Arcturus right aſc.	14	6	48
	24		
	38	6	48
Sun's right aſc.	16	27	46
	21	39	2
	12		
In the morning	9	39	2

That is, the ſtar Arcturus will be on the mer. of Greenwich 39 min. after nine in the morning.

Example II.

At what time will the ſtar Virgin's Spike be on the mer. of Greenwich, Sept. 1, 1806?

	H.	M.	S.
Virgin's Spike right aſc.	13	14	59
Sun's right aſc.	10	39	49
The ſtar culminates	2	35	10

So that the ſtar Spica Virginus, or Virgin's Spike, comes to the meridian of Greenwich at 35 minutes after two in the afternoon.

To find what Star comes on the Meridian at a given Time.

Rule. Add the time from noon to the ſun's right aſcenſion, the ſum will be the right aſcenſion of the ſtar required to be known; look in the Table of the ſtar's right aſcenſion, and find what ſtar's right aſcenſion agrees with, or comes neareſt to it; and that is the ſtar required.

Example I.

I would know what ſtar will be on the meridian of Greenwich about ten at night, Jan. 26, 1806?

	H.	M.	S.
☉ aſc. for noon. Jan. 26	20	33	19
And for 10 h. more		2	
given time 10 P.M.	10	0	0
	30	35	19
	24	00	00
Nearly anſw. to Sirius	6	35	19

Example II.

What ſtar will be upon the mer. of Greenwich 30 minutes paſt 4 A. M. May 10, 1806?

	H.	M.	S.
☉ right aſc. May 10 at noon and for 16 H.	3	6	31
		3	
more given time 16 hours 30 min. from noon of the 10th =	16	30	0
Anſwering nearly to Altair	19	39	31

Having found the time of the ſtar's coming to the meridian by the foregoing method; in order to determine whether you have obſerved by the right ſtar, obſerve the following rules:

1ſt. If the latitude in and declination be of the ſame name, ſubtract the declination from the latitude, the diff. ſubtracted from 90° gives the altitude.

2d. If the lat. and dec. be of contrary names, add the dec. to the lat. the ſum ſubtracted from 90° gives the alt. of the ſtar required.

Example

Example I.

What will be the altitude of Arcturus at Greenwich when on the meridian Jan. 25, 1806?

	H.	M.	S.
Lat. of Greenwich	51	28	40N.
✳ Declination	20	11	50N.
	31	16	50
	90		
✳ Altitude	58	43	10

Example II.

What will be the altitude of the star Virgin's Spike at Greenwich, Sept. 1, 1806?

	H.	M.	S.
Lat. of Greenwich	51	28	40N.
✳ Declination	10	8	39 S.
	61	37	19
	90		
✳ Altitude	28	22	41

Of the Celestial Globe.

The Celestial Globe is a round body, upon the surface of which is represented the concavity of the heavens; that is to say, a right line being drawn from the eye of the spectator, placed at its centre through any star thereon represented, will point to the same star in the heavens; whence it follows, that the celestial globe being elevated to the latitude of a given place, the sun's place in the ecliptic brought to the brazen meridian, and the hour index set to the upper twelve, by turning the globe round to any given hour, all the stars represented on the globe will point to their corresponding stars in the heavens; thus exhibiting all the stars at that time visible above the horizon.

From these data the following problems may be solved.

PROBLEM I.

Required the time of rising, passage over the meridian, and setting, of the star Regulus, on the 6th of Jan. 1805, in lat. 52° north?

First, elevate the pole as many degrees above the horizon as correspond with the given latitude, which, in this instance, is 52° north: then look in the horizon for the day of the month, which is the 6th of Jan. opposite to which stands 16° of Capricorn; find 16° of Capricorn on the ecliptic, and bring it to the eastern side of the brazen meridian; set the hour index to the upper twelve; then, by turning the globe round, you will find the star Regulus rises at a quarter before eight in the afternoon, comes to the meridian at a quarter before three in the morning, and sets at a quarter before ten in the forenoon.

PROBLEM II.

Required the altitude and azimuth of the star Regulus, at eleven o'clock in the afternoon of the 6th of January?

The sun's place being brought to the brazen meridian, as before, and the hour index set at twelve; screw the quadrant of altitude in the zenith, or over 52°, counted on the brazen meridian, from the equinoctial; turn the globe to the westward, till the hour index points to eleven; then lay the quadrant of altitude over the

the centre of the ſtar, and you will find its altitude, counted on the graduated edge of the quadrant, 30°, and its azimuth 18° eaſt, ſoutherly; that is, 108°, reckoned from the north point of the compaſs.

Thus may the time of riſing, paſſage over the meridian, and ſetting, of any ſtar, together with its altitude and azimuth, be found. But as ſhips are ſeldom provided with globes, we ſhall endeavour to work ſuch problems as are neceſſary for ſeamen to know, by the plans ſubjoined to this 17th edition.

The firſt plan divides the celeſtial globe into two equal parts, the northern and the ſouthern hemiſphere, extending from the equinoctial to each pole. Upon the equinoctial is marked in time and degrees, the right aſcenſion, beginning at the firſt point of Aries, and reckoning to the eaſtward, including 360°, or 24 hours.

The declination is reckoned in degrees, beginning at the equinoctial, and counting towards each pole, ending at 90°.

The ecliptic begins alſo at the firſt point of Aries, and ends at Libra, extending in the northern hemiſphere nearly 23° 28′. The other part of it begins at Libra, extends nearly 23° 28′ ſoutherly, and ends at Aries again. On this circle are marked the twelve ſigns of the zodiac, in which may be found the ſun's place for every day in the year. From this it is clear, any ſtar may be found, whoſe right aſcenſion and declination are known.

EXAMPLE I.

Required to find the ſtar Regulus?

Enter Table XV. where you will find the ſtar's right aſcenſion is 149° 30′ 15″, and declination 12° 54′ 38″ N. nearly.

Lay a ruler from the pole over the right aſcenſion; take the declination in your compaſſes, and ſet it off by the ſide of the ruler from the equinoctial, and that will give the place of the ſtar required.

EXAMPLE II.

Required to find the ſtar Aldebaran?

Enter Table XV. where you will find the ſtar's right aſcenſion is 66° 12′, and declination 16° 6′ 35″ N. nearly.

Lay a ruler from the pole over the right aſcenſion; take the declination in your compaſſes, and ſet it off by the ſide of the ruler from the equinoctial, and that will give the place of the ſtar required.

EXAMPLE. III.

Required to find the ſtar Antares?

In Tab. XV. before directed, find the ſtar's right aſcenſion and declination, which in this inſtance is 244° 22′ 45″ right aſcenſion, and declination 25° 59′ 16″ S. nearly.

Lay a ruler from the pole over the right aſcenſion; take the declination in your compaſſes; ſet it off along the ruler from the equinoctial, and it will give the ſtar's place as required.

This

This projection of the celestial globe upon the plane of the equator, is sufficient for the purpose of finding the stars in either hemisphere, independent of the other. But as it may in many instances be necessary to trace the relative situation of the stars in both hemispheres, another plan has been subjoined, which, it is trusted, will, together with the foregoing one, answer every situation the mariner may find himself in.

As it is very difficult to lay down a sphere on a plane, the following method has been suggested: that is, by laying down the equinoctial on a plane, and the hour circles extended in the same proportion as the degrees on the equinoctial, having the distance both to the north and south expanded so as to correspond nearly with those circles upon the globe itself, by which means the right ascension and declination will cut each other at right angles; the first reckoned from the first point of Aries, and the latter from the equinoctial, either north or south, having the ecliptic laid down as in the former plan. This plan being laid flat, pointing N. S. E. W. will shew the face of the heavens. The right ascension and declination of a star being given, it may easily be found by laying a ruler over the right ascension, and taking the degree of declination in the compasses, and laying it off from the equinoctial alongside the ruler. To prove which, let us make use of the first of the three foregoing examples. Thus, by laying a ruler over the right ascension of Regulus, which is 149° 30′ 15″, and taking the declination 12° 54′ 38″ N. in your compasses, and laying it off by the ruler, counting from the equinoctial, you will have the star's place as required. Any other star may be found by the same method.

The right ascension in these examples is given in degrees, but may easily be converted into time by Tab. XVI.

Some practical Directions for knowing the Stars.

Having shewn how to find the stars by their right ascension and declination, we shall next proceed to shew how they may be known by their mutual bearings and distances from each other. It was judged better adapted to the practice of seamen, to enable them to know the stars from which the moon's distance is computed in the Nautical Almanack, to give the bearings and distances of the brightest stars surrounding each of them, than by following the usual method of delineating the constellations, which are arbitrary appellations, there being no marks in the heavens bearing any resemblance to the forms in which they are usually exhibited.

1st. Required to know the star *a* Arietis, Jan. 6, 1806?

By the foregoing rules I find that *a* Arietis comes to the meridian at 7 h. 11 m. afternoon; and to be certain of this, I take his altitude, and find it correspond with my latitude, as before directed. For further conviction, I find the bright star Algol, bearing N. E. by N. distant about 23°; the star Menkar, S. E. by S. distant about 26°; the star Mirach, N. W. by W. 21°; and the star Shedir, N. N. W. 38°; as exhibited by dotted lines on the plan.

2d. Re-

2d. Required to know the ſtar Aldebaran, Nov. 25, 1806?

By the foregoing rules, I find that the ſtar Aldebaran comes to the meridian at 0 h. 2 m. 48 ſ. in the morning. For further ſatisfaction, I compare his altitude with my latitude; and further, I find the ſtar Capella bearing N. by E. ¼ E. diſtant about 30°; Betelgeux, E.S.E. 29°; Bellatrix, S. E. ½ E. 21°; and Pleiades, W. N.W. 16°.

3d. To know the ſtar Pollux. Find the time of his coming to the meridian as before, when you will ſee the following ſtars, viz. Acubens, bearing S. E. eaſterly, diſtant 28°; Procyon S. 23°; and Caſtor N. W. by W. 5°.

4th. To know the ſtar Regulus. Find the time of his culminating, as before; and further, you will ſee the two ſtars in the conſtellation of the Great Bear, called the Pointers, in the following bearings, viz. the Lower Pointer, N. by E. 46°; Dubhe, or the Upper Pointer, N. ½ E. 51°—N. B. A line drawn directly through the Pointers leads within a degree of the north pole ſtar.

5th. To know the ſtar Virgin's Spike. Find the time of her culminating; and further, you will ſee the ſtar marked α, in the conſtellation of the Croſs, bearing S. by W. diſtant about 53°; and a bright ſtar amongſt the Oars, marked β, bearing S.S.W. 71°.

6th. To know the ſtar Antares. Find the time of his culminating, as before; and further, you will ſee the ſtar Zubenelg, bearing N. W. by W. 29°; and Zubeneſch, W. by N. ½ N. 30°.

7th. To know the ſtar Altair, or α Aquilæ. Find the time of his coming to the meridian, as before directed; and further, you will ſee the ſtar Lyra, bearing N. N W. weſterly, diſtant about 36°; and Ras Alagus, W. by N. 46°; Ras Algethi, W. by N. northerly, 52°.

8th. To know the ſtar Fomalhaut, in the mouth of the Southern Fiſh. Find the time of his coming to the meridian, as before directed; and further, you will ſee the bright ſtar in the tail of the Whale, marked β, bearing E. N. E. 32°; Achernar, S. E. by S. 41°; and a ſtar in the preceding wing of the Crane, marked α, bearing S. S. W. 21°.

9th. The ſtar Markab, or α Pegaſi, will be known by finding the time of his culminating, as before; and further, you will ſee the ſtar Denib, bearing N. W. by N. 46°; Alderaimin, N. by W. ½ W. 55°; and Scheat, N. 13°.

The bearing and diſtance of a great number of the principal ſtars are here given, making thoſe from which the moon's diſtance is computed in the Nautical Almanack ſeverally the focus. Theſe directions may with eaſe be reduced to practice, by taking the diſtance with a ſextant or quadrant, and the bearing by the compaſs, allowing the variation.

Obſerving theſe rules will, in a ſhort time, render ſeamen expert in knowing the principal fixed ſtars.

N. B. The method of knowing the planets is given after Table XIX.

TO FIND THE APPARENT TIME, AND THEREBY REGULATE THE GOING OF THE WATCH.

IT is neceſſary here to premiſe, that there are three diviſions of time in uſe, the Civil, the Aſtronomical, and the Nautical. The Civil day begins at midnight, and ends at the midnight following, being divided into two equal parts of 12 hours each; the firſt 12 being marked A. M. that is, ante meridiem, or before noon; the latter 12, P. M. that is, poſt meridiem, or afternoon. This diviſion of time is moſt generally uſed.

The Aſtronomical Day, ſo called from its being uſed by aſtronomers, begins at the noon of the civil day, and continues to the noon of the civil day following (the hours being counted in regular ſucceſſion from 1 to 24) ſo that the firſt part of the aſtronomical day is the laſt part of the civil day; and the laſt part of the aſtronomical day includes the firſt part of the civil day following.

The Nautical Day, in uſe amongſt ſeamen, is, in one reſpect, the direct reverſe of the aſtronomical day, as it ends when the aſtronomical day begins. This it has in common with the civil day, that it is divided into two equal parts of 12 hours each, but the firſt twelve hours are marked P. M. and the latter 12 A. M. An example will beſt illuſtrate this. By the ſea reckoning, Tueſday begins immediately after meridian on Monday; all occurrences happening from Monday noon to midnight, though the firſt part of Tueſday by the nautical reckoning, are marked as happening at ſuch an hour P. M.; and all occurrences happening from midnight to Tueſday noon, are marked as happening at ſuch an hour A.M. Thus it appears that the hours in the nautical day are regulated by the civil day, but the nautical day itſelf begins 12 hours before the civil day. I have been the more explicit on this ſubject, as I do not remember to have ſeen it clearly elucidated in any book of navigation extant. From what has been ſaid, it will appear, that the noon of the civil day, the beginning of the aſtronomical day, and the end of the nautical day, take place at the ſame time,

The different kinds of time are two, mean and apparent. Mean time is that ſhewn by a clock or watch, regulated to mean ſolar time. Apparent time is reckoned from the paſſage of the ſun over the meridian of any place. Mean and apparent time will ſometimes differ from each other near a quarter of an hour, owing to the irregularity of the earth in her orbit, or the variation in the inclination of her axis. This difference is cal ed the equation of time, and is contained in page 2, in the Nau. Alm. It is only requiſite to take notice of it in determining the longitude by a time-keep r, but not in any other nautical obſervation, as the calculations in the Nau. Alm. are adapted to apparent time.

To

To find the apparent Time by equal Altitudes of the Sun.

Take the ſun's altitude at any convenient time in the forenoon, 2, 3, 4, or 5 hours diſtant from the meridian; ſet down the altitude with the correſponding time by watch exactly; ſet the index to the ſame altitude, and wait till the ſun comes to that altitude in the afternoon; note the time by watch; half the ſum of theſe two times is the apparent time ſhewn by the clock or watch, when the ſun was on the meridian of that place. But it muſt here be obſerved, that if the change of declination be conſiderable during the elapſed time, it muſt be allowed for, by adding the difference to, or ſubtracting it from, the ſecond altitude, according as it is increaſing or decreaſing. Leſt that an altitude taken in the forenoon, cannot, by the interpoſition of the clouds, have a correſponding one in the afternoon, it is adviſeable to take ſeveral in the forenoon, in order to ſecure a correſponding one in the afternoon. And if ſeveral equal altitudes can be taken on both ſides of the meridian, it will be beſt to find the noons for each pair, and the mean of all the noons thus found, for the true noon.

EXAMPLES.

May 20, 1806, ſuppoſe that at 8 h. 40 m. in the forenoon, and 3 h. 16 m. afternoon, by watch, the ſun had equal altitudes, and the going of the watch be required?

	H.	M.
Add together	12	0
	8	40
	3	16
	2)23	56
½ gives noon per watch	11	58
True noon - -	12	0
Watch ſlow - -		2

March 18, 1806, ſuppoſe at 8 h. 11 m. foren. and at 3 h. 58 m. 32ſ. aftern. you have equal altitudes of the ſun. Required the going of the watch?

The diſtance of the time from noon when the firſt alt. was taken, is 3 h. 49 m., and the daily decreaſe of decl. at this time is 23′ 43″ = 1423″, which, multiplied by the number correſponding to 3 h. 49 m. (T. XVII.) cut off four figures to the right hand, leaves 453″=7′ 33″.

Hence the index of the quadrant muſt be ſet 7′ 33″ forward on the arch, to correſpond with the morn. alt. whence the watch will be found 4′46″ too faſt.

Here it is ſuppoſed that the ſhip is lying too, or makes no way through the water; but if ſhe is ſailing to or from the ſun, proper allowance muſt be made for her run during the elapſed time.

To find the apparent Time by the Sun's Altitude.

Find the ſhip's latitude and longitude by account, at the time of obſervation, by carrying the reckoning forward to that time.

With a quadrant well adjuſted, take the altitude of the ſun's lower limb.

Take the difference between the ſemi-diameter and dip of the horizon, and add it to the obſerved altitude; the ſum will be the ſun's apparent altitude.

Take the difference between the ſun's refraction and parallax in altitude, and ſubtract it from the apparent altitude; the remainder will be the true altitude of the ſun's centre; hence the true zenith diſtance.

Turn the ſhip's longitude into time, and either ſubtract it from, or add it to, the time per watch, according as it is eaſt or weſt; the ſum or difference will be the reduced or ſuppoſed time at the place of obſervation.

Look in the Nautical Almanack, page 2 of the month, for the ſun's declination on the noon immediately preceding, and the noon immediately following the reduced time, and find their difference.

With half the reduced time take out the number (T. XVIII.) correſponding to the hours at top and minutes in the left-hand column, with which multiply the diff. of decl. cut off four figures from the right hand of the product, the remainder is the correction to be added or ſubtracted according as the decl. is increaſing or decreaſing the reſult is the decl. or reduced time at the ſhip; with this decl. find the polar diſtance; then add together the zen. diſt. co-lat. and polar diſt into one ſum.

From half this ſum ſubtract the zenith diſtance, noting the half ſum and remainder; then add together,

The log. co-ſecant of the comp. of the lat.
The log. co-ſecant of the polar diſtance,
The log. ſine of the half-ſum, and
The log. ſine of the difference into one ſum,
} Rejecting their indices.

Find the log. ſine of half the ſum of the four logarithms, which being doubled, and brought into time, as before, will give the time from the midnight before the altitude was taken.

Half the ſum of theſe four logarithms will give the log. co-ſine of half the hour angle, which being doubled and turned into time, by allowing fifteen degrees for every hour, &c. or more briefly by the table, will give the true time, if the altitude was taken in the afternoon; but if in the forenoon, its complement to 24 hours will be the true time, reckoned from the preceding, or noon before.

NOTE.—The refraction is found in Table VII of this book;
The dip of the horizon, Table VIII. in ditto;
The ſun's parallax in alt. Table IX. in ditto;
The ſun's declination in page 2, of the month; and,
The ſun's ſemi-di. in page 3, of the month, in the Nautical Almanack.

EXAMPLE I.

Suppoſe, on the 7th May, 1806, at 5 h. 30 m. 32 ſ. P. M. per watch, in lat. 39° 54′ N. and lon. 35° 30′ weſt of Greenwich, by account,

account, the altitude of the sun's lower limb should be found to be 15° 45′, the eye being 18 feet above the surface of the sea, and the true apparent time when the observation was made were required?

Obs. alt. sun's L. l.	15° 45′ 0″	Lat. - - - -		39° 54′ 0″
Semi. 15′ 52″ } Dip 4 4 } Diff.	+ 0 11 48			90 0 0
		Co. lat. - -		50 6 0
Ap. alt. sun's L. l.	15 56 48			
Refra. 3′ 17″ } Par. 0 8 } Diff.	− 0 3 9	Sun's decl. May 7th		16 41 56 N.
		Ditto - 8th		16 58 29 N.
Sun's true alt.	15 53 39	Diff. in 24 hours -		0 16 33
	90 0 0			
Zenith dist.	74 6 21	16′ 33″ × ,3282 gives	5 26	
		Sun's decl. 7th May -	16 46 5	
	H. M. S.			
Time at ship	5 30 32	True dec. for lon. and time	16 51 31	
Long. W. in time +	2 22 0		90 0 0	
Reduced time	7 52 32	Polar dist. -	73 8 29	
Co. lat.	50 6 0	Co. sec. } less rad.		0,11511
Polar dist.	73 8 29	Co. sec. }		0,01908
Zen. dist.	74 6 21			
Sum	2)197 20 50			
½ Sum	98 40 25	Log. sine - -		9,99500
Zen. dist.	74 6 21			
Remainder	24 34 4	Log. sine - - -		9,61885
		Sum 4 log. - - -		2)19,74804
	41 34 0	log. co-si. ½ Horary angle - -		9,87402
	2			H. M. S.
Hour angle	83 8 0	in time - - - - - - -		5 32 32
		Time at ship per watch - -		5 30 32
		Watch slow - - - - -		0 2 0

NOTE.—By turning the long. W. into time, and adding it to the time at the ship, gives the reduced time, 7 h. 52 m. 32 s. and the difference of declination between the 7th and 8th of May, is 16′ 33″ = 993″, which multiplied by 3282, a number found in T. XVIII. corresponding to 3 h. 56 m. 16 s. half the reduced time from the product; cut off four figures from the right, the remainder 5′ 26″ is the correction to be added to the dec. for May 7, gives the true declination at the reduced time. Or it may be worked thus:

As 24 h.	=	1440 m.	.. Log.	6,84164 co. ar.
Is to 16′ 29″	=	989″	.. Log.	2,99695
So is 7 h. 52 m. 32 s.	=	472 m.,533	Log.	2,67444
To 325″,9	=	5′ 26″	.. Log.	2,51303

NOTE.

NOTE.—If the reduced time be any even part of 24, as $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{6}$, &c. take ſuch aliquot part of the daily diff. of decl. and apply it to the decl. of the laſt noon; the ſum or diff. will be the true decl. at reduced time.

EXAMPLE II.

Suppoſe that in the forenoon, or A.M. on the 10th of October, 1806, in lat. 51° 30′ N. and long. 52° E. the alt. of the ſun's lower limb ſhould be found as under, the eye being 18 feet above the ſurface of the ſea, and the true apparent time of the day were required?

	H. M.	Alt.		
	20 14	12° 28′	Lat. -	51° 30′ 0″
	20 19	13 20		90 0 0
	20 30	14 51		
			Co. lat. -	38 30 0
	3)61 3	40 39		
			Sun's dec. Oct. 9th	6 6 25 S.
Mean	20 21	13 33	Ditto 10th	6 29 17 S.
Lon. E. in t. —	3 28			
			Diff. in 24 hours	0 22 52
Red. T.	16 53			
S.'s ſem. 16′ 3″ } Diff.		+0 11 59	22′ 52″ × ,7042 gives	16 6
Dip 4 4 }			Dec. Oct. 9, at n.	6° 6′ 25″
Ap. alt		13 44 59	Tr. dec. for lon. & t.	6 22 31
Refra. 3′ 48″ } Diff.		−0 3 39		90 0 0
Par. 0 9 }				
Sun's true alt.		13 41 20	Polar diſt.	96 22 31
		90 0 0		
Zenith diſt.		76 18 40		
Co-lat.		38 30 0	Co-ſec. } leſs. rad	0,20585
P. diſt.		96 22 31	Co-ſec. } leſs. rad	0,00270
Sum		2)211 11 11		
½ Sum		105 35 35	Log. ſine	9,98371
Zenith diſt.		76 18 40		
Remainder		29 16 55	Log. ſine	9,68940
			Sum 4 log.	2)19,88166
		60 39	log. ſine ½ hor. angle	9,94033
		2		
Hour angle		121 18		

			H.	M.	S.
Hour angle	121 18	in time from laſt mid.	8	5	12
		Time per watch	8	21	0
		Watch faſt	0	15	48

As the time is before noon, the ſine of half the ſum of the logs. is taken and doubled, which gives the hour angle, reckoned from the laſt midnight; for there ſeems to be no neceſſity for taking the co.ſine of half the four logs. unleſs the obſervation be made in the afternoon.

Another Method of finding the apparent Time.

RULE.

When the ſun or ſtar's declination and complement of latitude are both north, or both ſouth, their ſum*, but if one be north, and the other ſouth, their difference is the meridian altitude.

From the natural ſine of the ſun or ſtar's meridian altitude, ſubtract the natural ſine of the true altitude.

Then, the ſum of the log. co-ſec. of the comp. of the lat. the log. ſec. of the ſun or ſtars decl. rejecting their indices, and the log. of the difference of the natural ſines being found in the column of riſing, the hours, minutes, and ſeconds correſponding to it, will be the true time from the noon when the altitude was taken. We ſhall work the two foregoing examples by this method.

EXAMPLE I.

Co-latitude	50° 6′ 0″ N.	Log. co-ſec.	leſs. rad.	0,11511
Sun's decl.	16 51 30 N.	Log. ſec.		0,01908
Meridian alt.	66 57 30	N. ſine 92022		
True alt.	15 53 39	N. ſine 27386		
Diff. nat. ſines		64636	Its log.	4,81047
				4,94466

In col. of riſing gives true time 5h. 32′ 30″ the app. time P. M. of the given day differing 2″ from the other method.

EXAMPLE II.

Co-latitude	38°30′ 0″ N.	Log. co-ſec.	leſs rad.	0,20585
Sun's decl.	6 27 57 S.	Log. ſec.		0,00277
Meridian alt.	32 2 3	N. ſine 53042		
True alt.	13 41 20	N. ſine 23665		
Diff nat. ſines		29377	Its log.	4,46803
				4,67662

* If the ſum exceeds 90°, ſubtract it from 180°, and the remainder will be the meridian altitude.

Correſponding to 3h. 53′ 18″, the apparent time from noon, which ſubtracted from 12, leaves 8h. 6′ 42″, the apparent time on the morning obſervation.

A Queſtion for Exerciſe.

At ſea, April 18, 1806, in lat. 45° 37′ N. and lon. 50° 19′ W. from Greenwich, at 4 h. 20′ 30″, P. M. per watch, the alt. of the ſun's lower limb was found 25° 20′ 30″, the eye of the obſerver being 20 feet above the ſurface of the ſea. Required the apparent time of obſervation?

Anſwer,

	H.	M.	S.
True time	4	17	40
Ship's time	4	20	30
Watch too faſt	0	2	50

To find the apparent Time by the Altitude of a fixed Star.

Correct the obſerved altitude for the dip and refraction.

Find the ſhip's latitude by account, at the time of obſervation.

Find the ſtar's right aſcenſion and declination in T. XV.

From half the ſum of the zenith diſtance, co-latitude, and polar diſtance, ſubtract the zenith diſtance, noting the half ſum and remainder.

Then half the ſum of the log. co-ſec. of co-latitude; log. co-ſec. of polar diſtance; log. ſine of the half ſum; and the log. ſine of the remainder will be the log. co-ſine of half-hour angle; and when doubled, you will have the hour angle. Turn this hour angle into time, and apply it to the ſtar's right aſcenſion by ſubtracting it when the ſtar is eaſt of the meridian, or adding it when it is weſt of the meridian, their ſum or difference will be the right aſcenſion of the mid-heaven, or meridian.

From the right aſcenſion of the meridian (increaſed by 24 if neceſſary) ſubtract the ſun's right aſcenſion the preceding noon at Greenwich, taken from page 2d of the month in the Nautical Almanack, the remainder will be the apparent time at ſhip nearly.

To this time apply the longitude of the ſhip from Greenwich turned into time, by adding it when it is weſt, or ſubtracting it when it is eaſt, the ſum or difference will be the apparent time of the obſervation nearly by the meridian of Greenwich.

Then the daily variation of the ſun's right aſcenſion, multiplied by a number in T. XVIII. correſponding to half the app. time, cut off four figures from the right hand, the remainder is a number of minutes and ſeconds, which, ſubtracted from the above time, leaves the correct app. time at ſhip.

EXAMPLE I.

Suppoſe on Sept. 7, 1806, in lat. 7° 45′ ſouth, and lon. 30° 18′ eaſt of Greenwich, the altitude of the ſtar Procyon, being then eaſt of the meridian, ſhould be 28° 16′, and the eye 18 feet above the ſurface of the ſea. Required the true time?

Star's

Star's obf. alt.	28° 16′ 0″		90° 0′ 0″
Ref. 1′ 46″ } Sum Dip. 4 4 }	— 5 50	Star's dec. 1806	5° 43′ 36″N.
		Pol. dift.	95 43 36
Star's true alt.	28 10 10		
90° 0′ 0″			90° 0′ 0″
Lat. 7 45 0		Alt.	28 10 10
		Zen. dift.	61 49 50
Co-lat.	82° 15′ 0″	Co-fec.	0,00399
Polar dift.	95 43 36	Co-fec.	0,00218
Zen. dift.	61 49 50		
Sum	2)239 48 26		
Half fum	119 54 13	Sine -	9,93787
Zen. dift.	61 49 50		
Rem.	58 4 23	Sine -	9,92877
		Sum 4 logs.	2)19,87281
$\frac{1}{2}$ H < 30° 15′ 20″		Co-fine	9,93640
2			

	H. M. S.		H. M. S.
Ho.ang.60 30 40=	4 2 3	S.'s right afc. Sept. 7,	11 1 32
		Ditto Do. 8,	11 5 8
Star's right afcenfion	7 29 8		
		Daily difference	0 3 36
Right afcen. of mer.	3 27 5		
Increafed by	24 0 0	3,36 × ,6009 gives	2 10
	27 27 5	Time at fhip	16 25 33
S.'s right afc. at noon	11 1 32	Cor. fubtracted	0 2 10
Time at fhip nearly	16 25 33	True time	16 23 23
Ship's lon. 30° 18′ E.			12 0 0
in time	2 1 12		
		After midnight	4 23 23
Ti.at Greenw. nearly	14 24 21		

EXAMPLE II.

Suppofe, on April 14, 1806, in lat. 48° 56′ N. lon. 66° W. the obferved alt. of Aldebaran, when weft of the meridian, fhould be 22° 24′ 29″, the height of the obferver's eye 21 feet above the furface of the fea. Required the true apparent time at fhip?

Obf. alt. ftar Aldebar. 22° 24′ 29″

Refra. 2′ 18″ } Sum — 6 39 Star's dec. 1806 16° 6′ 35″
Dip 4 22 }

			H. M. S.
Star's true alt.	22 17 50	Star's right asc. 1806	4 24 48
	90° 0′ 0″	90° 0′ 0″	90° 0″ 0′
Lat. 48 56 0	Dec. 16 6 35	Alt.	22 17 50
	Polar dist. 73 53 25	Zen. dist.	67 42 10

Co-lat. 41 4 0 Co-sec. 0,18248
Pol.dis. 73 53 25 Co-sec. 0,01740
Zen.dis. 67 42 10

Sum 2)182 39 35

½ Sum 91 19 47 Sine 9,99988
Zen.dis. 67 42 10

Rem. 23 37 37 Sine 9,60290 ☉'s right asc. 14th 1 29 9
Ditto 15th 1 32 51

Sum 4 logs. 2)19,80266

Daily difference 0 3 41

½ H. < 37° 10′ 40″ Co-sine 9,90133
2

	H. M. S.		
Ho.ang. 74 21 20 =	4 57 25	3′ 41″ × ,5124 gives	1′ 53″
Star's right asc.	4 24 48		
			H. M. S.
Right asc. of mer.	9 22 13	App. time at ship	7 52 50
Sun's right asc.	1 28 16	Correction	0 1 53
App. time at ship	7 53 57	True time at ship	7 50 57
Lon. 66° W. in time	4 24 0		
App. time at Greenw.	12 17 57		

NOTE.—This method of finding the time is certain, could a good horizon be obtained in the night; but as that is seldom the case, it is best to regulate the watch by the sun.

The Method of finding the LONGITUDE *by the Moon's Distance from the Sun or a fixed Star, commonly called* THE LUNAR OBSERVATIONS.

A VARIETY of methods for discovering the longitude have at different times been brought forward, the most celebrated and practicable of which is that by means of measuring the angular distance of the moon from the sun or a fixed star. This method was originally proposed by John Werner, but owing to the imperfection

fection of instruments for measuring the angular distance, and the insufficient knowledge of the moon's true place, it could not, in his time, be brought to the degree of accuracy to which it is at present arrived.

These difficulties are at length happily surmounted by the invention of Mr. Hadley, in producing his Quadrant and Sextant; and by the ingenuity of Professor Mayer, of Gottingen, who has succeeded in constructing tables agreeing to the moon's motion in every part of her orbit, with surprising exactness.

Finding the difference of longitude between any two places, may be reduced to the problem of finding the difference of time between two places. For, as it is evident that the sun passes over a whole circle of the earth, or 360°, in 24 hours, it follows that the difference of time between the noon of one place and another, will always be the same proportional part of 24 hours, as the difference of their longitude is of 360°. *And the difference between any two given instants of time will be in like proportion.* For if an observer knew that at the same instant that it was two o'clock in the afternoon under the meridian where he was, it was only mid-day at another place, it would be clear he was 30° to the eastward of the given place: since 24 h. : 2 h. : : 360° : 30°, and the longitude is east, since the time at the place of observation is latest.

To ascertain the difference of longitude between the first meridian and a given place, the angular distance of the moon from the sun or a fixed star is to be observed. For as the distance of the moon from the sun and several fixed stars east and west of her is given in the Nautical Almanack, for every three hours, calculated for the meridian of the Royal Observatory at Greenwich, it is clear that the distance between the same objects being observed at any other place, the time at Greenwich may be deduced therefrom, which, compared with the apparent time, points out the difference of time, and, consequently, the difference of longitude between the two places.

As the angular distance of objects is conceived to be measured from their centres, the observed distance must be cleared from the effects of parallax and refraction, in order to obtain the true distance. For effecting which purpose, the following methods, by Mr. Lyons and Mr. Witchell, are the most in use.

The necessary Preparations for working a Lunar Observation.

1st. To reduce the time at ship to the time at Greenwich.

Turn the longitude of the ship, carried forward to the time of observation, into time, by allowing 15° for every hour, and add it to the time at ship, if the longitude be west, or subtract it if it be east; the sum or difference will be the supposed time at Greenwich, which call reduced time.

2d. To correct the observed altitude of the sun or star.

Take

Take the ſun's ſemi-diameter from page 2 of the month in the Nautical Almanack, from which ſubtract the dip of the horizon; the remainder, added to the obſerved altitude of the lower limb, or the ſum ſubtracted from the obſerved altitude of the upper limb, will give the true altitude of the ſun's centre.

From the ſun's refraction take his parallax in altitude, the remainder will be the correction of the ſun's altitude. This correction, ſubtracted from the apparent altitude, will give the true altitude of the ſun's centre.

If a ſtar has been obſerved, from the obſerved altitude ſubtract the dip of the horizon, the remainder is the ſtar's apparent altitude, from which take the refraction anſwering to that altitude, the remainder is the ſtar's true altitude.

3d. To correct the obſerved altitude of the moon.

Take the moon's ſemi-diameter and horizontal parallax from page 7 of the month in the Nautical Almanack, for the neareſt noon and midnight before and after the reduced time, and find their difference, which multiplied by the number found in Table XVIII, correſponding to the hours and minutes of reduced time, gives a number of ſeconds, which being added to the moon's ſemi-diameter at the noon or midnight immediately preceding the reduced time, if it be increaſing, but ſubtracted therefrom, if decreaſing, the ſum or difference will be the moon's ſemi-diameter at the time of obſervation. To the moon's ſemi-diameter, thus corrected, add the augmentation anſwering to her obſerved altitude, the ſum will be the moon's true ſemi-diameter: when the reduced time is any even part of 12 hours, as $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, or $\frac{3}{4}$; ſuch parts of the difference of the ſemi-diameter and horizontal parallax may be taken and applied as above, without being at the trouble of working by the numbers in Table XVIII.

From the moon's true ſemi-diameter ſubtract the dip of the horizon, the remainder, added to the obſerved altitude of the lower limb, or their ſum ſubtracted from the obſerved altitude of the upper limb, gives the apparent altitude of her centre.

To obtain the correction of the moon's altitude, proceed as follows:

Having taken out the horizontal parallax at the noon and midnight immediately before and after the reduced time, and having found their difference, as before directed,

Multiply it by the number found in Table XVIII, correſponding to the hours and minutes of reduced time, gives a number of minutes and ſeconds, which, being added or ſubtracted from the horizontal parallax, at the noon or midnight immediately preceding the reduced time, according as it is increaſing or decreaſing; the ſum or difference will be the moon's horizontal parallax at the duc e d time.

To the prop. log. of the moon's horizontal parallax add the log. ſecant leſs radius of the moon's apparent altitude, the ſum will

will be the prop. log. of the moon's parallax in altitude; from which take the refraction, the remainder will be the correction for the moon's altitude.

4th. To correct the observed distance.

To the observed distance of the sun and moon's nearest limbs, add both their semi-diameters, and the sum will be the apparent distance of their centres.

To the observed distance of the moon from a star, add the moon's semi-diameter, if her nearest limb was taken, but subtract it if her farthest limb was taken, the sum or difference will be the apparent distance.

NOTE. There are 12 pages in each month in the Nautical Almanack.

The sun's declination is found in page	II.
The sun's semi-diameter	III.
The moon's semi-dia and horizont. parallax	VII.
The distance of the moon from the sun, &c.	VIII IX X XI XII.

Having the apparent Altitude of the Object, and their apparent Distance, to find their true Distance, by Mr. LYON's *Method.*

1st. Add together the prop. log. of the correction of the sun or star's altitude, the log. co-sine of the sun or star's apparent altitude, the log sine of the apparent distance, and the log co-secant of the moon's apparent altitude; their sum (rejecting 30 in the index) will be the prop. log of the first arch.

2d. Add together the prop log. of the correction of the sun or star's altitude, the co-tang. of the sun or star's apparent altitude, the log. tang. of the apparent distance; their sum (rejecting 20 in the index) will be the prop. log of the second arch.

Take the difference between the first and second arches, which add to the apparent distance, if less than 90°, and the first arch be greater than the second, but if it be less subtract it.

But if the dist be more than 90°, adding both arches to the apparent dist. will give the dist. corrected for the refraction of sun or star

3d. Add together the prop. log. of the correction of the moon's altitude, the log. co-sine of the moon's apparent altitude, the log. sine of the dist. corrected for the sun or star's refraction, the log. co-sec. of the sun or stars true altitude; their sum (rejecting 30 in the index) will be the prop. log of the third arch.

4th Add together the prop. log of the correction of the moon's apparent altitude, the log. co-tang. of the moon's apparent altitude, the log. tang. of the dist. corrected for the sun or stars refraction; their sum (rejecting 20 in the index) will be the prop. log. of the fourth arch.

Take the difference between the third and fourth arches, and subtract it from the distance corrected for the sun or star's refraction, if

if lefs than 90, and the third arch be greater than the fourth; or, add it to the diftance corrected, if the fourth arch be greater than the third; but, if the diftance be more than 90°, the fum of both arches muft be fubtracted from it; and the fum or difference will be the diftance corrected for the fun or ftar's refraction, and the principal effect of the moon's parallax.

In Table XXVI. look for this laft corrected diftance in the top column, and the correction of the moon's altitude in the left-hand fide column; take out the number of feconds that ftand under the former and oppofite to the latter.

Look again in the fame table for the corrected diftance in the top column, and the principal effect of the moon's parallax in the left-hand fide column, and take out the number of feconds that ftand under the former and oppofite the latter. The difference between thefe two numbers muft be added to the corrected diftance if lefs than 90°, but fubtracted from it if more than 90°;

The fum, or difference, will be the true diftance.

Having the true Diftance and Time, to determine the Longitude.

IN the Nautical Almanack, among the diftances of the objects, look for the computed diftance between the moon and the other object obferved on the given day; if it be found there, the time at Greenwich will be at the top of the column, but if it falls between two diftances, as it generally will, take the difference between the diftances that ftand immediately before and after the computed diftance, and alfo the difference between the diftance ftanding before it and the computed diftance.

Then take the proportional logarithm of the firft difference, which is the difference in three hours, and the proportional logarithm of the fecond difference, which is the difference between the computed diftance and the diftance before it.

The difference between thefe two logarithms will be the proportional logarithm of a number of hours, minutes, and feconds, which being added to the time ftanding over the firft diftance in the Nautical Almanack, will give the true time at Greenwich.

The difference between Greenwich-time and that at the fhip turned into longitude, will be the longitude in, at the time the obfervations were made, which will be eaft if the time at the fhip be greater than that at Greenwich, but if it be lefs, the longitude will be weft.

Or the proportional part of time may be found by faying;

As the firft difference : is to 3 hours : : fo is the fecond difference : to a proportional part of time, which being added as above directed will give the true time at Greenwich.

NOTE. In working the following examples, it will fave fome time, if all the logarithmic fines, tangents, fecants, and proportional logarithms, which fall at the fame opening

opening of the book, be taken out at the same time, both in the first and second part of the operation.

Thus, the co-sine and co-tangent of the star's apparent altitude, and co-secant of its altitude, may all be taken out at the same time, and written down in different parts of the paper (or in a formula) and so may the co-sine, co-tangent, and co-secant of the moon's apparent altitude, the sine and tangent of the apparent distance, and the sine and tangent of the distance corrected, for the refraction of the sun or star.

EXAMPLE I.

Suppose, on the 23d of May, 1809, in longitude 13° 13' west of Greenwich by account at 6h. 10m. P. M. by a watch well regulated, the distance of the sun and moon's nearest limbs were observed to be 104° 38' 14", when the moon's altitude of her lower limb was 43° 20' 20", the altitude of the sun's lower limb 12° 39' 28", the eye of the observer 29 feet above the surface of the sea. Required the true longitude?

	H. M.		M. S.		M. S.	
Time by watch	6 10	☽'s semi-dia. n.	15 41	☽'s hor. par. at noon	57 33	
Long. in time +	54	Do. midnight	15 49	Do. midnight	58 1	
Red. time	1 4	Diff. in 12 hours +	8	Diff. in 12 hours +	28	
		8 × 5888 gives +	5	28 × 5888 gives +	16	
☉'s obs. alt. 12° 39' 28"		☽'s semi-dia. noon	15 41	☽'s par. at noon	57 33	
Se. dia. 15 49, Dip 4 17	11 32		15 46	☽'s par. at red. ti.	57 49	P.L. 0.4932
		Augmentation	11	☽'s ap. alt.	43 32	Sec. 0.1397
App. alt.	12 51 0					
☉'s ref. 46, ☉'s par. 9	— 3 57	☽'s semi-dia.	15 57	☽'s par. in alt.	41 55	P.L. 0.6329
		Dip	4 17	Refraction —	1	
☉'s true alt.	12 47 3		11 40	☽'s correction	40 55	
	Obs. alt.	43 20 20	Ap. dist. of ☉ and ☽'s nearest limbs	104° 38' 14"		
			☉ and ☽'s semi-dia. 15 49 + 15 47	31 46		
	☽'s ap. alt.	43 32 0				
			☽'s App. dist.	105 10 0		

To find the Distance by Mr. LYON's *Method.*

	D. M. S.					
Cor. for ☉'s ap. alt.	3 57	P.L. 1 6587			P.L.	1 6587
☉'s ap. alt.	12 51 0	Co-sine 9 9890			Co-tang.	0 6418
App. Dist.	105 10 0	Sine 9 9846			Tang.	0 5669
☽'s ap. alt.	43 32 0	Co-sec. 0 1619	First arc	2' 53"		
			Second arc	14	P.L.	2 8674
First arc	2 53	P.L. 1 7942				
	Cor. for ☉'s refrac.			3 7		
	App. dist.			105 10 0		
	Dist. correc. for ☉'s refrac.			105 13 7		
Cor. for ☽'s ap. alt.	40' 55"	P.L. 0 6434			P.L.	0 6434
☽'s ap. alt.	43 32 0	Co sine 9 8603			Co-tang	0 0222
Correc. dist.	105 13 7	Sine 9 9845			Tang.	0 5654
☉'s alt.	12 47 3	Co-sec. 0 6551				
			Fourth arc	10' 34"	P.L.	1 2319
Third arc	12 57	P.L. 1 1433	Third arc	12 57		
	Principal effects of the ☽'s par.			23 31		
	Dist. correc. for ☉'s refraction			105 13 7		

Dist.

Dist. cor. for ☉'s ref. and prin. ef. of ☽'s par.		104 49 36	
Cor. from table 16 } Ditto 19 } Difference		— 3	
To determine the Longitude.	True distance	104 49 33	
Dist. at 6 hours 104 13 8		104 13 8	
Do. at 9 hours 105 46 19			
		36 25	P. L. 6940
1 33 11			P. L. 2859
	Time over first dist.	6	
		1 10 20	P. L. 4081
N.B. The longitude is west, because the time at the ship is least.	True time at Greenwich	7 10 20	
	Time at ship	6 10	
	Long. in time	1 0 20	= 15° 5′ W.

EXAMPLE II.

Suppose, on the 10th of March, 1809, in longitude 23° east of Greenwich, at 5 h. 36 m. P. M. by a watch well regulated, the distance of the sun's nearest limb to the sun was 68° 9′ 57″, when the altitude of the sun's lower limb was 31° 48′ 9″, the alt. of the moon's lower limb 23° 41′ 7″, the height of the eye of the observer 18 feet above the sea, the true longitude is required?

	H. M.		M. S.		M. S.	
Time at Ship	5 36	☽ semi dia. at noon	16 1	hor. par. noon	58 48	
Long. in time	1 32	Do. at midnight	15 58	Do. midnight	58 35	
Red. time	4 4	diff. in 12 hours—	3	diff. in 12 hours—	11	
		3 × ,3388 gives—	1	11 × ,3388 gives—	4	
Obs. alt. of ☉ LL	31 48 9	semi-dia. at n.	16 1	hor par. noon	58 46	
☉ semi-dia. 16 7 } Dip. 4 4 }	+ 12 3	semi-dia.	16 0	H. P. red. time	58 42	P L 4866
		Augmentation	7	☽ app. alt. 24 0 10		Sec. 0393
App. alt.	32 0 12					
Refrac. 1 31 } ☉ par. 8 }	— 1 23	☽ semi-dia.	16 7	☽ par. in alt.	53 38	P L 5259
		dip. for 18 feet	4 4	refrac.	— 2 8	
☉ true alt.	31 58 49		12 3	cor. ☽ alt.	51 30	
		☽ Obs. alt.	23 41 7			
				Obs. dist. ☉ and ☽	68° 9′ 57″	
		☽ App. alt.	24 0 10	dia. ☉ and ☽ 16 7 + 16 7 +	32 14	
				App. dist. of centres	68 42 11	

To find the Distance by Mr. Lyon's Method.

Cor. for ☉'s app. alt.	1′ 23″	P. L.	2 1143		P. L.	2 1143
☉'s app. alt.	32 0 12	Co-sine	9 9284		Co-tang.	0 2042
App. distance	68 42 11	Sine	9 9693		Tang.	0 4091
☽'s app. alt.	24 0 10	Co-sec.	0 3907			
				2d arc.	21″ P.L.	2 7276
First arc.	43	P. L.	2 4027	1st arc.	43	
	Correction for ☉'s refrac.			+ 22		
	App. dist.			68 42 11		
	Corrected dist.			68 42 33 for ☉'s ref.		

	° ′ ″				
Cor. for ☽'s app. alt.	51 30	P. L.	0 5435	P. L.	0 5435
☽'s app. alt.	24 0 10	Co-sine	9 9607	Co-tang.	0 3514
Corrected distance	68 42 33	Sine	9 9693	Tang.	0 4093
☉'s true altitude	31 58 49	Co-sec.	0 2761		
			4th arc. 8′ 56″	P. L.	1 3042
Third arc.	32 2	P. L.	0 7496 3d. arc. 32 2		

Principal effects of ☽'s par.	— 23 6
Dist. corrected for ☉'s refraction	68 42 33
	68 19 27
First correction in Table XXVI 9, Second ditto ditto 2 } difference	+ 7
True dist.	68 19 34

To determine the longitude

	True distance	—		68° 19′ 34″	
By Nau. Alm. the dist. at three hours	68° 49′ 8″			68 49 8	
Ditto at six hours	67 13 6		diff.	29 34	P. L. 7845
H. M. S.					
1 40 35	diff.	1 36 2			P. L. 2729
+ 5				H. M. S.	
				3 55 25	P. L 5116
8 22 55		time at ship		5 36	
+ 3		diff. long in time		1 40 35 = 25° 1′ 45″ E	
25 8 45 Long. east.					

EXAMPLE III.

Suppose that about ¾ past four P. M. on the 26th Nov. 1809, in lat. 54° 25′S. long. by account 10° E. six observations were made, the mean of which were taken at 4hs. 44m. and the altitude was 27° 42′ 35″ the error of the instrument, 24″, to be added, the eye of the observer 21 feet above the surface of the sea, required the true time?

	H. M.		° ′ ″		° ′ ″		
Mean time at ship	4 44	obs. alt. ☉ L. L.	27 42 35	zen. dist.	62 6 49		
Long. 10° E.	— 40	error of quad.	+ 24	co. lat	35 35 0	co-sec.	0 23516
				pol. dist.	69 2 56	co-sec.	0 02971
Ti. at Greenwich	4 4	☉'s se. di. 16′ 14″	27 42 59				
		Dip 4 23	+ 11 51		166 44 45		
☉'s dec. 26th Nov.	20 56 39						
Ditto 27th	21 7 52	ref. 1 47	27 54 50		83 22 22	sine	9 99708
		☉'s par. 8	— 1 39		62 6 49		
Diff. in 24 hours	11 13						
11′ 13″ × ,1695 gives	+ 47	true alt.	27 53 11		21 15 33	sine	9 55943
Long. 10° E. gives	— 22		90				
							19 82138
☉'s dec.	20 57 44	zen. dist.	62 6 49				
	90	latitude	54 25		35° 30′	sine	9 91069
	—		90		2		
Pol. dist.	69 2 56						H. M.
		Co. lat.	35 35		71 0	in time	4 44

On the same evening the following observations were made of the distance of the star Regulus from the moon's farthest limb, lon. by account as before, and the error of the instruments by which the moon's altitude and distance were taken was 7′ 30′ 25′ to be added; the true longitude is required?

Times

	Times.	Alt. of Regulus.	Alt. of ☽'s Low. Limb.	Dist. of ☽ and ✱
	H. M. S.	° ' "	° ' "	° ' "
	10 44 37	19 50 30	19 54 43	31 30 43
	10 27 29	20 2 0	19 9 43	31 30 30
	10 30 4	20 15 0	19 28 13	31 33 0
	10 32 8	20 29 0	19 48 43	31 34 0
	10 34 16	20 40 0	19 57 43	31 35 45
5	52 38 34	101 16 30	97 14 5	157 44 58
	10 33 43	20 15 18	19 29 49 + 7 30	31 32 59 + 25
Mean	10 33 43	20 15 18	19 34 19	31 33 24

	H. M. S.				
Time at ship	10 33 43	☽'s hor. par. noon	54 16		
Long. in time	40	Ditto midnight	54 23		
Reduced time	9 53 43	Diff. in 12 hours	+ 7		
☽'s se. dia. noon	14 47	7 × 825 gives	+ 6		
Ditto midnight	14 49	☽'s hor. par. noon	54 16		
Diff. in 12 hours	+ 2		54 22	P. L.	0 5199
☽'s semi-dia.	14 49	☽'s app. alt.	19 44 50	Sec.	0 0263
Augmentation	+ 5	Hor. par. red. ti.	51 10	P. L.	0 5462
☽'s semi-dia.	14 54	Refraction	− 2 37		
Dip	− 4 23				
		☽'s correction	48 33		
	10 31	✱'s obs. alt.	20 15 18		
☽'s obs. alt.	19 34 19	Dip.	− 4 23		
☽'s app. alt.	19 44 50	✱'s app. alt.	20 10 55		
Obs. dist of ☽ and ✱	31 33 24	Refraction	− 2 34		
☽'s semi dia.	− 14 54				
		✱'s true alt.	20 8 21		
Ap. dist. of ☉ & ☽ cent.	31 18 30				

To find the Distance by Mr. Lyon's *Method.*

✱'s correc. 2 34 P.L. 1 8459 | P.L. 1 8459 | ° ' "
✱'s app. alt. 20 10 55 co-sine 9 9725 | co-tang. 0 4347 tr. dist. 31 13 43
App. dist. 31 18 30 sine 9 7157 | tang. 9 7840 dist. 9h. 31 41 2
☽'s app. alt. 19 44 50 co-sec. 0 4713 | ' "
2d arc. 1 33 P. L. 2 0646
First arc. 1 46 P. L. 2 0054 1st arc 1 46 | first diff. 27 19
+ 13 | dist. at 9h. 31 41 2
31 18 30 | dist at 12h. 30 13 9

Distance corrected for the ✱'s refrac. 31 18 43 | ° ' "
☽'s correc. 48 33 P.L. 9 5691 | P.L. 0 5691 2d diff. 1 27 53
☽'s ap. alt. 19 44 50 co-si. 9 9737 | co-tan. 0 4449 1st diff. 27 19 p.l. 8188
Cor. dist. 31 18 43 sine 9 7157 | tang. 9 7841 2d diff. 1 27 53 p.l. 3117
✱'s tr. alt. 20 8 21 co-se. 0 4631 4th ar. 38 39 P.L. 0 7981
ti. 1st diff. 9 | 55 58 p.l. 5071
Third arc. 34 11 P.L. 0 7216 3d arc. 34 11

Prin. effects of the ☽'s par. − 5 32
31 18 43 | Greenwich time 9 55 58
Time at ship 10 33 43
Cor. Tab. XXVI. 33" } 31 13 11
Ditto 1 } diff. + 32 | Long. in time 37 45 = 9° 26' 15" E.
True dist. 31 13 43

Here I have given one method of finding the longitude, illustrated by a sufficient number of examples, all of which are reduced to the year 1809, in order that the reader, or teacher, may have sufficient time to furnish himself with a N. A. for that year, which is now printed. But as many would wish to have some other method of reducing the distance, that, by comparing them together, they may not only have the advantage of proving their calculations, but also of making choice of which they prefer to work by; the second method I shall present the Reader with, is chiefly deduced from that invented by Mr. Witchell, late Master of the Royal Academy at Portsmouth, as it is short, and requires but four places of figures in the logarithms, besides the index; the preparations in both methods being exactly the same.

RULE.

First. Add the sun, or star's and moon's apparent altitudes together, half the sum; subtract the less from the greater, and half the difference; then add together, the co tang. of half the sum, the tang. of half the difference, and the co-tang. of half the apparent distance; their sum (rejecting 20 in the index) will be the log. tang. of an angle, which call A.

Secondly. When the sun or star's altitude is greater than the moon's, take the difference between angle A, and half the apparent distance; but if less, take their sum. Then add together the co-tang. of this sum or difference, the co-tang. of sun or star's apparent altitude, and the prop. log. of the correction of the sun or star's altitude; their sum (rejecting 20 in the index) will be the prop. log. of the first correction.

Thirdly. If the sum of angle A and half the distance was taken in the last article, take now their difference, but if their difference, now take their sum; then add together the co-tang. of the sum, or difference, the co-tang. of the moon's apparent altitude, and the prop. log. of the correction of the moon's apparent altitude; their sum (rejecting 20 in the index) will be the proportional logarithm of the second correction.

Fourthly. When the angle A is less than half the apparent distance, the first correction must be added to, and the second subtracted from, the apparent distance; but when the angle A is greatest, their sum must be added to the apparent distance, when the sun or star's altitude is less than the moon's; but when the moon's altitude is least, their sum must be subtracted to give the corrected distance.

Fifthly. In Table XXVI. look for the corrected dist. in the top column, and the correction of moon's alt. in the left-hand side column; take out the number of seconds that stand under the former and opposite to the latter. Look again in the same Table for the corrected distance in top column, and the second correction in the left-hand side column; take out the number of seconds that stand under the former and opposite the latter, the difference be-

tween these two numbers will be the third correction, which must be added to the corrected distance, if less than 90°, but subtracted from it, if more than 90°; the sum, or difference, will be the true distance.

To illustrate this last method of reducing the apparent distance to the true distance, I shall take the apparent altitudes and distances as they stand in the first examples, worked by the former method.

EXAMPLE I. See Example I. p. 231.

Given, the apparent distance of the sun and moon's centres. 105° 10′ 0″, the sun's apparent altitude 12° 51′, that of the moon 43° 32′, and horizontal parallax at reduced time 57′ 49″. Required the true distance of their centres by Mr. Witchell's method?

	M.	S.					
☉'s refrac.	4	6	☽'s hor. par. at red. ti.	57	49	P.L.	0 4932
☉'s parallax		9	☽'s ap. alt.	42	32	Sec.	0 1397
☉'s correc.	3	57	☽'s par. in alt.	41	55	P.L.	6329
			Refraction —		1		
			☽'s correction	40	55		

☉'s ap. alt.	12°	51′	0					
☽'s ap. alt.	43	32	0					
Sum	56	23	0	Half sum	28	11	Co-tang.	10 2710
Diff	30	41	0	Half diff.	15	20	Tang.	9 4381
Ap. dist.	105	10	0	Half dist.	52	35	Co-tang.	9 8837
1st. cor.	+	3	8					
				Arc A	21	23	Tang.	9 5928
	105	13	8					
2d cor.	−	23	33	Sum	73	58	Co-tang.	9 4584
				☉'s ap. alt.	12	51	Co tang.	10 6418
	104	49	35	☉'s cor.	3	57	P.L.	1 6587
3d cor.			3					
				1st. cor.	3	8	P.L.	1 7589
Tr. dist.	104	49	32					
				Diff.	31	12	Co-tang.	0 2178
				☽'s ap. alt	43	32	Co-tang.	0 0222
				☽'s cor.	40	55	P.L.	0 6434
				2d cor.	23	33	P.L.	0 8834

EXAMPLE II. See Example p. 232.

Given, the apparent distance of the sun and moon's centres 68° 42′ 11″, the sun's apparent altitude 32° 0′ 12″, apparent altitude of the moon 24° 0′ 10″, the sun's correction 1′ 23″, the moon's correction 51′ 30″. What is the true distance of their centres by Mr. Witchell's method?

sun's

☉'s ap. alt 32° 0 12″
☽'s ap. alt. 24 0 10

Sum	56 0 22	Half ſum	28° 0′ 11″	Co-tang.	0 2743
Diff.	8 0 2	Half diff.	4 0 1	Tang.	8 8447
Ap. diſt.	68 42 11	Half diſt.	34 21 5	Co-tang.	0 1653
1ſt. cor.	+ 22				
		Arc A	10 53 30	Tang.	9 2843
	68 42 33				
2d cor.	— 23 8	Diff.	23 27 35	Co-tang.	0 3625
		☉'s ap. alt	32 0 12	Co-tang.	0 2042
	68 19 25	☉'s cor.	1 23	P.L.	2 1143
3d cor.	+ 7				
		1ſt. cor.	22	P.L.	2 6809
True diſt.	68 19 32				
		Sum	45 14 35	Co-tang.	9 9963
		☽'s ap. alt.	24 0 10	Co-tang.	0 3514
		☽'s cor.	51 30	P.L.	0 5435
		2d correc.	23 8	P.L.	0 8912

EXAMPLE III. See Example p. 233.

Given, the apparent diſtance of the moon's centre from the ſtar Regulus 31° 18′ 30″, the apparent altitude of the ſtar 20° 10′ 55″, that of the moon 31° 18′ 30″, the ſtar's correction 2′ 34″, that of the moon's correction 48′ 33″. What is the true diſtance of their centres by Mr. Witchell's method?

✳'s ap. alt. 20° 10′ 55″
☽'s ap. alt 19 44 50

Sum	39 55 45	Half ſum	19° 57′ 52″	Co-tang.	0 4398
Diff.	26 5	Half diff.	13 2	Tang.	7 5788
Ap. diſt.	31 18 30	Half diſt.	15 39 15	Co-tang	0 5525
1ſt. cor.	+ 14				
		Arch A	2 7 59	Tang.	8 5711
	31 18 44				
2d cor.	— 5 36	Diff.	13 31 16	Co-tang.	0 6190
		✳'s ap. alt.	20 10 55	Co-tang.	0 4347
	31 13 8	✳'s cor.	2 34	P.L.	1 8459
3d cor.	+ 34				
		1ſt. cor.	14	P.L.	2 8996
True diſt.	31 13 42				
		Sum	17 47 14	Co-tang.	0 4937
		☽'s ap. alt.	19 44 50	Co-tang.	0 4450
		☽'s correc.	48 33	P.L.	0 5691
		2d correc.	5 36	P.L.	1 5078

First.

Another Method.

Firſt. From half the ſum of the apparent altitudes of the ſun and moon, or moon and ſtar, and the apparent diſtance, ſubtract the ſun or ſtar's apparent altitude; the difference call the firſt remainder, the moon's apparent altitude taken from the half ſum leaves the ſecond remainder.

Secondly. To the log. ſine of thirty degrees add the log. ſine of the apparent diſtance, the log. co-ſine of the moon's apparent altitude, the log. ſecant of the half ſum, the log. co-ſecant of the firſt remainder, and the prop. log. of the moon's correction; reject the tens in the index, the remainder will be the prop. log. of the firſt correction.

Thirdly. To the log. ſine of thirty degrees add the log. ſine of the apparent diſtance, the log. co-ſine of the ſun or ſtar's apparent altitude, the log. ſecant of the half ſum, the log. co-ſecant of the ſecond remainder, and the prop. log. of the ſun or ſtar's correction; reject the tens in the index, the remainder will be the prop. log. of the ſecond correction.

The difference between the correction of the moon's altitude, and the firſt correction, call the difference of corrections.

Enter Table XXVI. with the apparent diſtance at the top, and the moon's correction in the left-hand ſide column, the correſponding number will be the third correction; in the ſame column, and correſponding to the difference of corrections, you may find the fourth correction.

Fifthly. Subtract the moon's, the ſecond, and fourth corrections from the apparent diſtance, to the remainder add the ſun or ſtar's, the firſt and third correction; the ſum will be the true diſtance.

EXAMPLE I. See Example p. 231.

Given, the apparent diſtance of the ſun and moon's centres 105° 10′, the ſun's apparent altitude 12° 51′, that of the moon 43° 32′, the ſun's correction 3′ 57″, and the moon's correction 40′ 55″. Required the true diſtance?

	30°	0′	Sine	9 6990		9 6990	☽'s cor.		40′	55″
Ap. diſt.	105	10	Sine	9 9846		9 9846	2d cor.			49
☽'s ap alt.	43	32	Co-ſine	9 8603			4th cor.			19
☉'s ap. alt.	12	51	Co-ſine			9 9890			——	—
	——	—						—	42	3
Sum	161	33						105	10	0
Half ſum	80	46	Secant	0 7946		0 7946		——	——	——
1ſt. rem.	67	55	Co-ſec.	0 0331				104	27	57
2d rem.	37	14	Co-ſec.			0 2182	☉'s cor.		3	57
☉'s cor.	3	57	P.L.		2d	1 6587	1ſt. cor.		17	23
☽'s cor.	40	55	P.L.	0 6434	cor.	———	3d cor.			16
				—— ——	49″P.L.	2 3441		——	——	——
1ſt. cor.	17	23	P.L.	1 0150			True diſt.	104	49	33
	——	——								
Dif. cor.	23	32								

EXAMPLE

EXAMPLE II. See Example p. 2.

Given, the apparent distance of the sun and moon's centres 68° 42′ 11″, the sun's apparent altitude 32° 0′ 12″, apparent altitude of the moon 24° 0′ 10″, the sun's correction 1′ 23″, the moon's 51′ 30. Required the true distance?

	30°	0′	0″	Sine	9 6990	9 6990	☽'s cor.		57′	30″
Ap. dist.	68	42	11	Sine	9 9693	9 9693	2d cor.		1	0
☽'s ap.alt.	24	0	10	Co-si.	9 9607		4th cor.		0	1
☉'s ap.alt.	32	0	12	Co-si.		9 9284				
							Sum −		52	31
Sum	124	42	33					68	42	11
Half sum	62	21	16	Secant	0 3335	0 3335				
1st. rem.	30	21	4	Co-se.	0 2964			67	49	40
2d rem.	38	21	6	Co-sec.		0 2073	☉'s cor. +		1	23
☉'s cor.		1	23	P.L.		2 1143	1st. cor. +		28	22
☽'s cor.		51	30	P.L.	0 5435	2d ——	3d cor. +			9
					——	cor. 2 2518				
1st. cor.		28	22	P.L.	8024	1′0″ P.L.	True dist.	68	19	34
Diff. of cor.		23	8							

EXAMPLE III. See Example p. 233.

Given, the apparent distance of the moon's centre from the star Regulus 31° 18′ 30″, the apparent altitude of the moon 19° 44′ 50″, the apparent altitude of the star 20° 10′ 55″, the star's correction 2′ 34″, the moon's correction 48′ 33″. What is the true distance of their centres?

	30°	0′	0″	Sine	9 6990	9 6990	☽'s cor. −		48′	33″
Ap. dist.	31	18	30	Sine	9 7157	9 7157	2d cor. −		2	20
☽'s ap.alt	19	44	50	Co-sine	9 9737		4th cor. −			0
✳'s ap.alt.	20	10	55	Co-sine	9 9725					
							Sum —		50	53
Sum	71	14	15				Ap. dist.	31	18	30
Half sum	35	37	7	Secant	0 0900	0 0900				
1st. diff.	15	26	12	Co-sec.	0 5748			30	27	37
2d. diff.	15	52	17	Co-sec.		0 5631	✳'s cor. +		2	34
✳'s cor.		2	34	P.L.	2d	1 8459	1st. cor. +		42	57
☽'s cor.		48	33	P.L.	0 5691	cor. ——	3d cor. +			34
					——	1′20″ 1 8862				
1st. cor.		42	57	P.L.	6223	P.L.	True dist.	31	13	42
Diff. of cor.		5	36							

The difference in this last method is that there is no variety of cases.

Questions for Exercise.

Suppose, on the 23d of May 1805, in longitude 9° west of Greenwich, by account at 3 h. 41 m. 15 s. P.M. by a watch well regulated, the distance of the sun and moon's nearest limbs should

be

be obferved to be 67° 5′ 36″, at the fame time the altitude of the fun's lower limb fhould be 31° 48′ 15″, the moon's 23° 48′ 15″, the eye of the obferver being 18 feet above the furface of the fea. Required the true longitude of the place?

Anfwer. 11° 20′ 15″ weft.

Suppofe, at fea in longitude of 10° weft by account, on June the 5th, 1805, the mean of five obfervations were taken; viz. at 3 h. 17 m. 20 f. P.M. the diftance of the fun and moon's neareft limbs were 106° 18 m. 12 f. the error of the fextant 2 m. 37 f.—the altitude of the moon's upper limb 20° 4′ 6″, the error of the quadrant 1 m.—the altitude of the fun's lower limb 45° 22′ 3″, the error of the inftrument 48 f.—the eye being 21 feet above the fea. Required the true longitude?

Anfwer. 5° 59′ weft.

Suppofe, on the 1ft. of January 1806, in longitude 8° eaft of Greenwich, by account at 5 h. 56 m. A.M. per watch well regulated, the diftance of the moon's fartheft limb from the ftar Pollux fhould be 62° 52′ 28″, the altitude of the moon's lower limb being 15° 19′ 14″, and the ftar's altitude 29° 51′ 39″, the eye of the obferver being 18 feet above the furface of the fea, and the true longitude fhould be required?

Anfwer. 7° 36′ 30″ eaft.

NOTE.—In veffels which afford only one obferver, it will be found fufficiently exact for practice to have a quadrant at hand, in order to take the altitudes of the objects immediately after the diftance is obferved, as the difference of altitudes which take place during the time fpent in the operation will be nearly infenfible. It is recommended to take the altitude of the fun firft. But as it may fometimes happen, owing to the obfcurity of the horizon, that the altitudes cannot be taken, the following methods are given to obtain them by calculation:

To find the Sun's true Altitude.

It fometimes happens that the diftance of the celeftial objects may be taken, but for want of a good horizon, or affiftants, their altitudes cannot be taken at the fame time; to fupply fuch deficiencies, obferve the three following cafes.

CASE I.

The apparent time, the fhip's latitude, longitude, and the fun's declination given, to find the true altitude of his centre.

RULE.

If the fhip's co-latitude, and the fun's declination, be both north or both fouth, take their fum; but if one be north and the other fouth, their difference is the fun's meridian altitude.

With the apparent time from noon, enter Table XXIII. and from

from the column of rifing take out the logarithm correfponding to it.

To this logarithm add the log. co-fine of the latitude, and the log. co-fine of the fun's declination.

Their fum, rejecting 20 in the index, will be the logarithm of a natural number, which, being fubtracted from the natural fine of the fun's meridian altitude, will leave the natural fine of his true altitude at the given time.

EXAMPLE I.

Required the true altitude of the fun's centre, in latitude 49° 57′ N. when its declination is 19° 26′, at 6 h. 56 m. 30 s. in the morning?

	H.	M.	S.			
	12	0	0			
App. time	6	56	30			
Time from noon	5	3	30	Its log. in col. of rifing		4,87850
Latitude	49	57	0 N.	Its log. co-fine		9,80852
Decl. at that time	19	26	0 N.	Its log. co-fine		9,97453
Co-lat.	40	3	0	Rej. 20 N.N. 45872 = log. =		4,66155
Mer. alt.	59	29	0	Nat. fine	86148	
				Nat. fine true alt.	40276 = 23° 45′.	

EXAMPLE II.

What will be the true altitude of the fun's centre at London, when its declination is 20° 49′ S. at 3 h. 21 m. 30 s. apparent time in the afternoon?

	H.	M.	S.			
App. time from N.	3	21	30	Its log. in col. of rifing		4,55900
Latitude	51°	32′	N.	Log. co-fine		9,79383
Decl. at that time	20	49	S.	Log. co-fine		9,97068
Co-lat.	38	28	N.	Nat. num. 21062 = log =		4,32351
Mer. alt.	17	39		Nat. fine	30320	
Nat. fine true alt.	5	19		Nat. fine	09258	

CASE II.

The Apparent Time, the Latitude and Longitude given, to find the Altitude of any of the known fixed Stars.

RULE.

Turn the longitude into time, and add it to or ſubtract it from the time at the ſhip, according as it is eaſt or weſt, the ſum or difference will be the time at Greenwich.

Take the ſun's right aſcenſion from the Nautical Almanack, proportion it to the time at Greenwich, and add it to the apparent time at the ſhip, which will give the right aſcenſion of the meridian, or mid-heaven.

Find the ſtar's right aſcenſion and declination in Table XX. and take the difference between its right aſcenſion and the right aſcenſion of the meridian, which will be the diſtance of the ſtar from the meridian.

Having the ſtar's diſtance from the meridian, with its declination and the ſhip's latitude, the true altitude is found in the ſame manner as has been ſhewn in the laſt examples of finding the true altitude of the ſun.

EXAMPLE.

What will be the true altitude of Aldebaran, April 11, 1806, at 5h. 56m. 20s. P. M. apparent time, in latitude 55° 58′ N. and long. 3° 6′ W.?

	H.	M.	S.
App. time at ſhip - - -	5	56	20
Long. 3° 6′ W. in time -	0	12	24
Time at Greenwich -	6	8	44
Sun's right aſcen. Apr. 11, at n. by N. A. -	1	17	14
Prop. part, for 6h. 8m. 44s.	0	0	56
Sun's right aſc. at time of obſ.	1	18	10
App. time at ſhip - -	5	56	20
Right aſc. of the meridian	7	14	38
Star's right aſcenſion -	4	24	48
Star's diſt. from meridian	2	49	42

Star's diſt. from meridian	2	49	42		Log. col. of rif	4,41803
Lat. -	55°	58′	0″ N.		L. co-ſine	9,74794
Star's dec.	16	6	35 N.		L. co-ſine	9,98260
Co-lat.	34	2	0			
				Nat. n. 14079	Log. -	4,14857
Mer. alt.	50	8	35	N. ſine 76773		
True alt.	38	49	0	N. ſine 62694		

CASE

CASE III.

The apparent Time, the Latitude and Longitude of the Ship being given, to find the true Altitude of the Moon's Centre.

RULE.

Turn the longitude into time, and if it be weſt add it to, but if it be eaſt ſubtract it from, the apparent time at the ſhip, and it will give the time at Greenwich.

Take the ſun's right aſcen. out of the N. A. and proportion it to Greenwich-time, which, being added to the time at the ſhip, the ſum will be the right aſcenſion of the meridian or mid-heaven.

Take out of the N. A. the moon's right aſcenſion and declination, and proportion them to the time at Greenwich. Turn the moon's right aſcenſion into time, and take the difference between it and the right aſcenſion of the mid-heaven, which will be the diſtance in time of the moon from the meridian.

Having the ſhip's lat. together with the moon's declin. and diſt. from the meridian, the true altitude is found, in the ſame manner as has been ſhewn in finding the true altitude of the ſun and ſtar.

EXAMPLE.

What will be the moon's true altitude April 28, 1809, at 6h. 20m. P. M. in lat. 42° 34′ S. and long. 84° 30′ weſt of Greenwich by account?

	H.	M.			°	′
App. time at ſhip	6	20		Moon's dec. at noon	7	54 S.
Long. 84° 30′ in ti. +	5	38		2° 10′ × by, 9973 gives +	2	9
Red. time	11	58		Moon's dec. at red. ti.	10	3
	H.	M.	S.			
☉'s ri. aſc. 28 ap.	2	21	31	☽'s ri. aſc. at noon	194	37
3′ 45″ ×, 4986 gives +		1	52	7° 10′ ×, 9973, gives +	7	9
Ri. aſc. at red. time	2	23	23		201	46
App. time at ſhip. +	6	20		In time =		6h. 47m. 4s.
AR of the meridian	8	43	23			
☽'s right aſcenſion	6	47	4			
☽'s diſt from mer.	1	56	19	Log. in col. of riſing		3 93960
Sip's latitude	42	34		Log. co-ſine		9 86717
☽'s dec.	10	3		Log. co-ſine		9 99328
Comp. lat	47	26				
				Nat. num.	6310	3 80005
Mer. alt.	57	29		Nat. ſine	84324	
True altitude	51	16		N. ſine	78014	

In the laſt example, proportional parts are taken in finding the right aſcenſion, declination and log. riſing.

By

By the three laſt caſes the true altitudes of the objects are found, therefore if the apparent altitudes be wanted, the difference between the ſun's parallax and refraction muſt be added to the ſun's true altitude, the refraction muſt be added to the true altitude of a ſtar, and the difference between the moon's refraction and parallax in altitude muſt be ſubtracted from the true altitude of the moon thus found, to obtain the reſpective apparent altitudes of their centres.

To find the Longitude by the Eclipſes of Jupiter's Satellites.

On the day preceding the evening on which it is propoſed to obſerve an eclipſe, look for the time when it will happen at Greenwich, in page 3d of the month in the Ephemeris. Find the diff. of longitude either by a good map, ſea chart, or dead reckoning.

Let the watch be regulated by the ſun with all poſſible exactneſs to the apparent time. Turn the difference of longitude into time, and add it to, or ſubtract it from, the apparent time, according as it is eaſt or weſt of Greenwich, the ſum or difference will be nearly the time when the eclipſe is to be looked for in that place. But as the longitude is uncertain, it will be proper to begin 20 or 30 minutes before.

Obſerve the hours, minutes and ſeconds of the beginning of the eclipſe, called immerſion, that is, the very inſtant that the ſatellite appears to enter into the ſhadow of Jupiter; or the emerſion, that is, when it appears to come out of the ſame. The difference of time between the obſerved immerſion, or emerſion, and that ſet down in the Nautical Almanack, being turned into degrees, will give the difference of longitude between Greenwich and the place of obſervation.

Theſe obſervations made on the firſt ſatellite, or that which moves neareſt to the body of Jupiter, is the moſt proper for determining the longitude; and here it may be obſerved, that its emerſions are not viſible from the time of Jupiter's conjunction with the ſun to the time of his oppoſition to the ſun, and that its immerſions are not viſible from the time of the planet's oppoſition to the ſun, to the time of its conjunction.

The configurations, or the poſitions in which Jupiter's ſatellites appear at Greenwich, are laid down every night when viſible, in page the 12th of the month in the Ephemeris.

EXAMPLE.

Suppoſe on Jan. 8, 1809, in long. 18° 23′E. by account, an emerſion of Jupiter's firſt ſatellite was obſerved at 11h. 3m. apparent time, required the longitude?

	H.	M.	S.
At Greenwich that day the emerſion began at	9	50	26
Obſerved emerſion at ſhip	11	3	0
Diff. in time	1	12	34

turned

turned into longitude gives 18° 8′ 30″ E, becaufe the time at Greenwich is lefs than at the place of obfervation, the error in the longitude is 5 miles and 49 fecants.

As thefe eclipfes happen almoft daily, they afford the moft ready means of determining the longitude of place on land, and then the longitudes of fea-coafts might be better afcertained than they are at prefent; they might alfo be applied at fea, could they be obferved with fufficient accuracy in a fhip under fail, which can hardly be done, fince the leaft motion of a telefcope that magnifies fufficiently to make thefe obfervations, would throw the objects out of the field of view.

The eclipfes of Jupiter's fatellites may be well obferved by one of Dolland's new achromatic telefcopes of three feet in length, or by a reflecting telefcope of 18 or 20 inches focal length.

To find the Longitude by the Eclipfes of the Moon.

This is performed by comparing the times of the beginning or ending, as alfo the times when any number of digits are eclipfed, or when the earth's fhadow begins to touch or leave any remarkable fpot on the moon's face.

Then will the difference of time between the like obfervations made at different places, turned into degrees, be their difference of longitude,

But thefe eclipfes happen too feldom to be of any general ufe at fea.

To find the Longitude by a Chronometer or Time-keeper.

When it is intended to make ufe of a time keeper, it is requifite to examine its rate of going before you leave the land, and adjuft it to the meridian of the place from which you reckon your longitude. To do this, you muft afcertain the apparent time by the fun's altitude (or by fome other method) and apply to it the equation of time, taken from page 2, of the Nautical Almanack, according to its title of *add* or *fubtract*; the fum or difference will give the mean time of obfervation: this, compared with the watch, will fhew how much it is too faft or too flow, and by obferving this difference for feveral days fucceffively, you will afcertain its rate of going: if you find it gain or lofe a few feconds per day, you muft make that allowance on all future obfervations at fea. Inftead of comparing the time fhewn by the chronometer, to the mean time at the place of obfervation found as above, you may compare it with that mean time reduced to Greenwich-time, by adding to that mean time the difference of longitude between Greenwich and the place of obfervation, when it is to the weftward of Greenwich, but fubtracting it when to the eaftward; and by this means you will find how much your chronometer differs from Greenwich-time. Having thus regulated your time-keeper, the longitude at fea is readily found by it, as will evidently appear by the following examples:

EXAMPLE

EXAMPLE I.

Suppose that on March 25, 1809, the apparent time was found by an altitude of the sun to be 1h. 5m. 9s. P. M. when, by a time-keeper well regulated to mean Greenwich time, it was 4h. 3m. 6s. P. M. Required the longitude?

		H.	M.	S.
Apparent time	- -	1	5	9
Equation of time	- +	0	6	12
Mean time		1	11	21
Time per watch	-	4	3	6
		-2	51	45

equal to 42° 56′ 15″ of west longitude, because the time at Greenwich is greater than the time at ship.

EXAMPLE II.

Suppose that on Sept. 12, 1809, the apparent time was found by an altitude of the sun to be 4h. 3m. 6s. P. M. when the time per chronometer is 2h. P. M. the watch being too slow for mean Greenwich time 11m. 9s. Required the longitude?

	H.	M.	S.			H.	M.	S.	
Apparent time	4	3	6	P. M.	Time per watch	2	0	0	
Equat. of time	−0	3	46		Watch error	+0	11	9	
Mean time	3	59	20	P. M.	Time at Greenw.	2	11	9	P. M.
Ti. at Greenw.	2	11	9						
Diff. of time	1	48	11						

Diff. of time 1 48 11 equal to 27° 2′ 45″ east longitude.

OBLIQUE TRIGONOMETRY.

AXIOM II.

IN all plane triangles the sides are in direct proportion to the sines of their opposite angles.

To find a Side.

As the sine of an angle
Is to its opposite side,
So is the sine of either of the other angles in the same triangle
To the side opposite thereto.

To find an Angle.

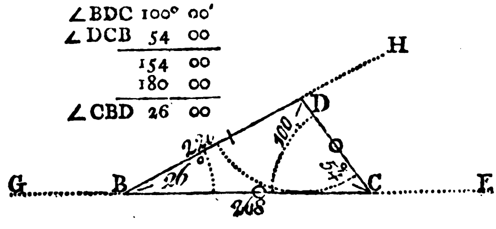
As any side given
Is to the sine of its opposite angle,
So is either of the other sides in the same triangle
To the sine of its opposite angle.

CASE I.

Two angles and one side given, to find either of the legs?

The angle BDC=100° and angle DCB=54°. And the leg. BD=220° are given to find the sides.

∠BDC	100°	00′
∠DCB	54	00
	154	00
	180	00
∠CBD	26	00



CONSTRUCTION.

Draw an indefinite line GE, add the two angles D and C together, and subtracting their sum from 180° leaves the remaining angle B 26°, on the line GE; on any point as at B, describe the angle B 26, and on BH set off BD 220. On D make the angle BDC 100°, then DC will interfect the line GE in the point C, which completes the triangle, and BC will meafure on the fame fcale from which BD was laid down 268 nearly, and DC 119 alfo on the fame fcale.

To find CB.		To find DC.	
As the fine of the ang. C 54° co. ar.	0,09204	As fine ang. C 54° co. ar.	0,09204
Is to the fide BD 220	2,34242	Is to the fide BD 220	2,34242
So is fupt. fi. of ang. BDC 80°	9,99335	So is fine ang. B 26°	9,64184
To the fide BC 267.8	2,42781	To fide DC 119.2	2,07630

By Gunter.

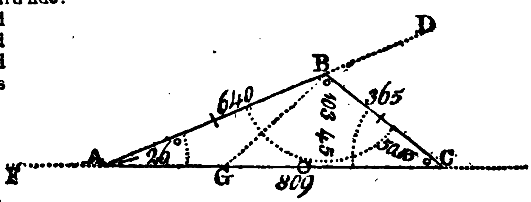
1ft. The extent from 80° to 54°, on the line of fines, will reach from 220 to 267, on the line of numbers for BC.

2d. The extent from 54° to 26°, on the line of fines, will reach from 220 to 119, on the line of numbers for the fide DC.

CASE II. and III.

Two fides and an angle oppofite to one of them being given, to find the other oppofite angles and the third fide?

The fide BC 365, and the fide AB 640, and angle A 26 given, to find the fide AC, and angles ABC and BCA.



CONSTRUCTION.

Draw the indefinite line FE, and on any point thereon, as at A, draw the angle DAE 26. On AD fet off AB=640, then on B, with 365 in your compaffes, taken from the fame fcale, defcribe an arch which will cut FE in the point C. Join BC, and it is done; AC will meafure on the fcale before ufed 809 nearly, the angle B will meafure on the fcale of chords 103¾, and angle C 50¼ nearly.

Proportion by Axiom II.

To find the angle C.		To find AC.	
As the fide BC 365 co. ar.	7,43771	As fine ang. C 50° 14′ co. ar.	9,11427
Is to the fine of angle A 26°	9,64184	Is to AB 640	2,80618
So is the fide AB 640	2,80618	So is fi. ang. B, or its fuppl. 76° 14′	9,98734
To fine angle C 50° 14′	9,88573	To fide AC 808.7	2,90779

Angle A add	26	0
Subtract	76	14
from	180	
Angle B	103	46

It may be proper to obferve, that if the given angle be obtufe, the angle fought will be acute; but when the given angle is acute, and oppofite a given leffer fide, then the required angle is doubtful whether acute or obtufe, it ought therefore to be determined before the operation; for it is plain the above proportion produces 50° 14′ for the required angle, but if it is obtufe, its fupplement to 180° muft be taken, viz. 129° 46′.

By Gunter.

1ft. The extent from 365 to 640, on the line of numbers, will reach from 26° to 50° 14′ on the line of fines, equal to the angle B.

2d. The extent from 50° 14′, to 76° 14′, on the line of fines, will reach from 640 to 809′ on the line of numbers, equal AC.

AXIOM III.

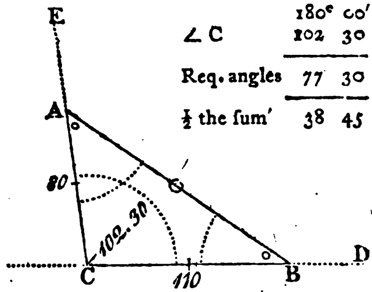
In every plane triangle it will be as the ſum of any two ſides is to their difference, ſo is the tangent of half the ſum of the angles oppoſite theſe ſides, to the tangent of half their difference, which half difference being added to half the ſum of the angles, gives the greater angle, but, being ſubtracted, the remainder will be the leſſer angle.

CASE IV. and V.

Two ſides and their contained angle being given, to find either of the other angles and the third ſide?

The ſide BC 110, AC 80, and angle BCA 102° 30′, to find the angle BAC and CBA.

Side BC	110
Side AC	80
Sum ſides	190
Diff. of ſides	30



	180°	00′
∠ C	102	30
Req. angles	77	30
½ the ſum	38	45

CONSTRUCTION.

Draw the indefinite right line CD, on which ſet off CB=110, make the angle ACB=102° 30′, then on AC ſet off CA 80, join AB, and it is done, for AB will meaſure on the former ſcale 149, and the angles A and B will meaſure 45° 58′, and 31° 32′, reſpectively, on the line of chords.

The proportion by Axiom III. will be,

To find the angles B and A.		To find the ſide AB by Axiom III.	
As the ſum of the ſides AC and BC 190 co. ar	7,72125	As ſine ang. B 31 32 co. ar.	0,28150
Is to their difference 30	1,47712	Is to AC 80	1,90309
So is tan. ½ ſum op. angles 38° 45′	9,90449	So is ſine ang. C 102 30 or its ſup. 77 30	9,98958
To tang. half diff. 7° 13′=	9,10286	To ſide AB 149.3	2,17417
Added, gives the ang. A 45 58			
Sub. leaves the angle B 31 32			

By Gunter.

1ſt. The extent from 190 to 30, on the line of numbers, will reach from 38° 45′ to 7° 13′ on the line of tangents for half difference.

2d. The extent from 77° 30′, which is the ſupplement of 102° 30′, to 31° 32′ on the line of ſines, will reach from 80° to 149° 3′, on the line of numbers, for the ſide AB required.

The Learner may be at a loſs how to know to which angles the above ſum and difference belong, but let him remember the greateſt angle is oppoſite to the greateſt ſide, and the contrary, which will determine it.

AXIOM IV.

In any plane triangle, it will be
As the greateſt ſide
Is to the ſum of the other two ſides,
So is the difference of thoſe ſides
To the difference of the ſegments of the baſe made by a perpendicular, let fall from the angle oppoſite the baſe.

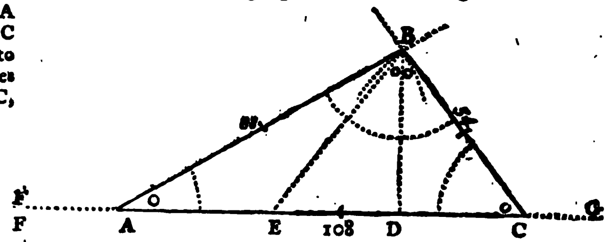
And half the difference of the ſegments added to half their ſum will give the greater ſegment, but if ſubtracted from their half ſum will leave the leſſer ſegment, the triangle being thus cut becomes two right angled triangles, the hypothenuſes and baſes of which are given, to find the angles by Axiom I. in right angled Trigonometry, page 34.

CASE

CASE VI.

The three fides of a plane triangle given, to find the angles

The fide BA 88, BC 54, AC 108, given to find the angles ABC, BAC, BCA.



CONSTRUCTION.

Draw the indefinite right line FG, on which, from any point therein, as at A, fet off AC 108, then, 88 in your compaffes, and one foot on the point A, fweep an arch alfo with the diftance 54 in your compaffes, and one point on C, fweep another arch interfecting the former arch in the point B, and it is done; BA, BC, AC, will meafure 88, 54, 108 refpectively on the fame fcale.

The proportion by Axiom IV.

AB 88
BC 54

To find AE=AD—DC the diff. of fegments.

142	Sum of fhorteft fides	As the fide AC 108 co. ar.	7,96658
34	Diff. ditto	Is to the fum of fides AB and BC 142	2,15229
		So is diff. fides AB and BC 34	1,53148
Half bafe	54		
Half diff. fegm.	22,35	To AE the diff. of feg. of bafe 44, 7	1,65035
AD	76,35 Great fegm.		
DC	31,65 Leaft fegm.	Half	22,35

Having divided the triangle into two right-angled triangles, the hypothenufe and bafes of which are given, to find the angles by Axiom I. as follows:

To find the angle DAB.			To find the angle DBC.		
As the hypothenufe AB 88 co. ar.		8.05552	As hypoth. BC 54 co. ar.		8.26761
Is to radius	90°	10.0000	Is to radius	90°	10.0000
So is fide AD the great feg. 76.35		1.88281	So is DC 31.65		1.50037
To fine ang. CBD	60° 11′	9.93833	To fi. ang. CBD	35° 53′	9.76798
	90			90	
The com. is ang. A=29 49			Its com. ang. C=54 07 + ang. A. 29° 49′= 83 56 and 180—83° 56′= ang. B 96° 4′		

OBLIQUE SAILING.

We come next to the doctrine of oblique triangles applied to problems of failing: and though it may be applied to the meafuring of inacceffible objects, yet we fhall confine it to thofe problems which are more immediately neceffary in navigation, and is chiefly ufed in taking the maps of harbours, fea-coafts, &c. as follows.

Oblique Sailing exemplified by proper Example

CASE I.

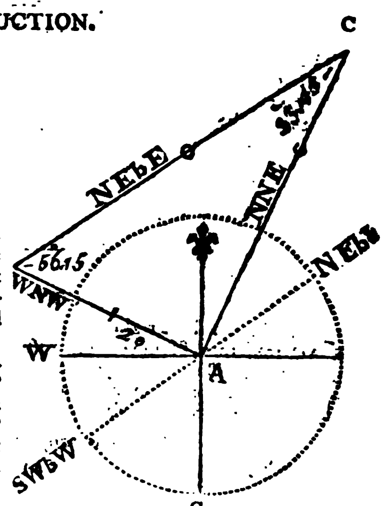
The bearing and diftance of two places from each other, as alfo the bearing of each of them from a third place, being given, to find the diftance from the faid third place to each of the other two places.

EXAMPLE.

Coafting along fhore, I faw a cape of land which bore from me N. N. E. I ftood away W. N. W. 20 miles, and the fame cape bore from me N. E. by E. I would know the diftance of the fhip at both ftations from the cape?

Having

CONSTRUCTION.



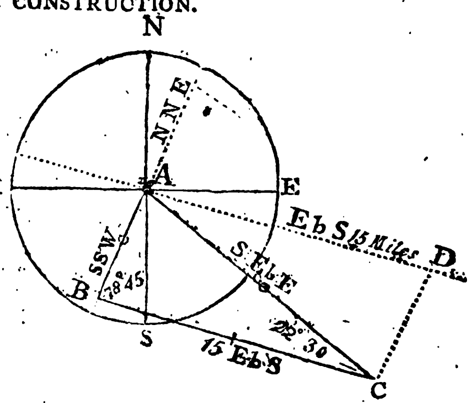
Having drawn the compafs N. E. S. W. let A reprefent the place of the fhip at her firft ftation, from whence, through the N. N. E. point, draw the indefinite right line CA, alfo through the W. N. W. point, draw another indefinite right line, BA, and fet off thereon 20 miles from a fcale of equal parts from A to B; through the centre of the compafs alfo draw the N. E. by E. and S. W. by W. points, and parallel thereto from the point B, draw the line BC meeting the N. N. E. in the point C, and it is done; now from the N. eaftward, 2 points, and from the N. weftward 6 points, together make 8 points for the ∠ BAC, alfo the difference between the N E. by E. and N. N. E. points are 3, or=33° 45'=∠BCA, and the difference between W.N.W. and S. W. by W. points is 5 or 56° 15'=∠ABC, then the ∠ACB+∠ABC= 90°, therefore the other is a right angle, or 90°.

To find the diftance AC.			To find the diftance BC.		
As fine ang. ACB	33° 45' co. ar.	0.25526	As fine ang ACB	33 15 co. ar.	0.25526
: AB	20 mi.	1.30103	: AB	20 mi.	1.30103
:: Sine ang. ABC	56 15	9.91985	:: S. ang. BAC=	90 00	10.00000
: AC dift. from her 1ft ftation 29.93 miles.		1.47614	: dift. BC	= 36 mi.	1.55629

EXAMPLE II.

Being at fea, I faw two headlands, whofe bearing from one another I found by the chart to be W. by N. and E. by S. diftance 15 miles, the northernmoft bore from me S. S. W. and the fouthernmoft S. E. by E. I demand my diftance from each of the faid headlands?

CONSTRUCTION.



Having drawn the compafs, fet off AB the S. S. W. bearing and AC the S. E. by E. bearing, draw through the centre the dotted line reprefenting the bearings of the two places from one another, and from A towards D, on this line, fet off from any fcale of equal parts, 15 miles from A to D, and draw AB; draw DC parallel to BA until it cuts AC at the point C, through C draw BC parallel to AD, and it is done.

Calculation of the Angles

Between N. N. E. and E. by S. is 7 points, or 78° 45'=∠ABC, between S. S. W. and S. E. by E. is 7 points, or 78° 45'=the angle BAC, and between W. by N. and N. W. by W. is two points, or 22° 30', the angle ACB.

Calculation of the Sides.

As fine	78° 45' co. ar.	0.00843	It being an ifofceles triangle.
Is to BC=15 miles		1.17609	AC=BC 15 miles.
So is fine ∠ C 22 30		9.58284	
To AB=5 85 miles.		0.76736	

This

This example, and the first, are used for finding the distance of a ship from any headland, &c. when the ship is about to take her departure from the land.

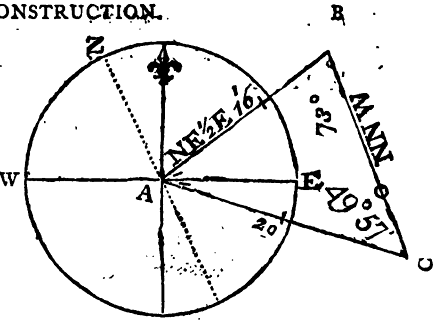
CASE II.

The bearings and distance of two places from each other, and the distance of one of those places and the bearing of the other from a third place being given, to find the bearing of the first, and the distance of the second from the third place.

EXAMPLE I.

Admit two ships sail from the same road, one sails N. E. ½ E. 16 miles, the other sails 20 miles, and then finds the first to bear N. N. W. I demand the distance between the two ships?

CONSTRUCTION.



1st. Having drawn the compass, let A be the place the ships departed from, and draw the N. E. ½ E. line AB equal 16 miles.

2d. From B draw the right line BC parallel to N. N. W. then with 20 miles between the compasses, setting one foot in A, with the other intersect the line BC as in C, and join AC, then is the ∠BAC the course which the second ship steered, reckoned from the N. E. ½ E. southerly.

Calculation of the Angles.

The bearing from B to C is S. S. E. the opposite point to N. N. W. which is two points, also A bears from the same point B, S. W. ½ W. the opposite point to N. E. ½ E. which is 4½ points and two from the S. easterly, make 6½ points for the ∠ABC, from whence you find the ∠C thus:

As the side AC=20 miles	co. ar.	8.69897
Is to the sine of the ∠ABC 6½ points=73° 7' 30"		9.98088
So is the side AB 16 miles		1.2 412
To the sine of the ∠C 49° 52'		9.88397
From N. N. W. add 22 30		
Sum makes 72 22 from the N. westerly.		

Which being counted from the N. N. W. makes AC to bear 72° 22' westerly whence the ship's course was from A to C 72° 22' easterly, or E. S. E. ½ E. nearly.

To find the Distance of the two ships from one another.

The ∠ABC=73° 7		As sine ∠ABC=73° 07'	co. ar.	9.01912
∠C=	49 52	Is to side AC=20		1.30103
		So is sine ∠ 57,1		9.92367
Sum	122 59			
	180	To side BC—17,5 miles		1.24382
∠A	57 01			

CASE III.

The bearings and distances of any two places from a third being given, to find the bearings of the said places, and their distance from each other.

EXAMPLE I.

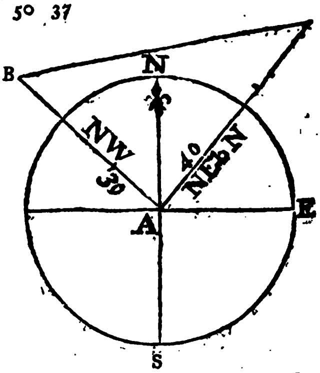
Admit two ships set sail from the same port, one whereof sails N. W. 30 miles, the other sails N. E. by N. 40 miles. I demand their bearings and distance from each other?

CONSTRUCTION.

To calculate the Angles.

N. E. by N. 3 points	33° 45′		Side AB	30
N. W. 4 points	45		Side AC	40
∠BAC	78 45		Sum of sides	70
	180		Difference	10
Sum of unknown ∠s.	2)101 15			
½ sum opp. angles	50 37			

From A set off the N. W. course AB, which make 30 miles, also draw the second ship's course AC, and set off B thereon 40 miles from the same scale; join BC, and it is done.



As sum of si. AB & AC=70 co. ar.		8,15490
Is to their difference	10	1,00000
So is tang. ½ sum opp. ∠s 50 37		10,08570
To tang. ½ diff.	9 52½	9,24060

Angle B	Sum	60 30
Angle C	Diff.	40 45
Angle A		78 45
	Sum	180 0
Angle C	40 45	
N. E. by N.	33 45	
Sum	74 30	

the bearing of B from C, or W. by S. ½ S. nearly.

To find the Distance from each other.

As the si. angle B. 60° 30′ co. ar.	0,06030
Is to side AC 40′	1,60206
So is sine ang. A 78° 45′	9,99157
To their dist. BC=45.01	1,65393

CASE IV.

The mutual distances of three places from each other, and also the bearing of any two of them being given, to find the several bearings of these two from the third place.

EXAMPLE.

Admit there be two ports lying E. by N. and W. by S. distance 400 miles, a ship from the easternmost sails northerly, 450,7 miles, another from the westernmost sails 300 miles and meets the first. I demand the course steered by each ship?

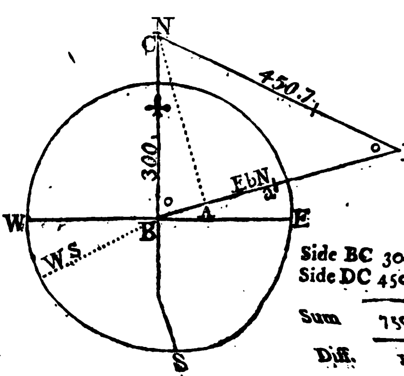
CONSTRUCTION.

1st. Having drawn the compass N. E. S. W. let B, the centre, represent the westernmost port, and draw the E. by N. line B D, on which set off 400 miles to D, then will D be the easternmost port.

2d. With 300 between your compasses, and one foot on B, describe an arch.

3d. With 45 in your compasses, and one foot on D, describe another arch intersecting the former arch, as at C, join C B and C D.

4th. Making B D the base from C, let fall the perpendicular C A thereon, which will divide the oblique angled triangle B C D into two d triangles B C A



Side BC	300
Side DC	450,7
Sum	750,7
Diff.	150,7

By *Axiom* IV.		
As the base B D 400 co. ar.		7,39794
Is to sum of sides BC and CD 750,7		2,87547
So is diff. of sides BC and CD 150,7		2,17811
To diff. segts. of base	282 8	2,45152
Half which	141 4	
Add to ½ base	200 0	
Sum is gr. segt. AD =	341 4	
Diff. = the less. segt. AB	58 6	

To find the Course from B, *in* ∠BCA.

As hypoth. BC	300 co. ar.	7,52288
Is to radius	90	10,00000
So is AB	58,6	1,76790
Co-sine ang. B	78° 44′	9,29078
Add E. by N.	11 15	

To find the Courf efrom D, *in* △ ACD.

As the hypoth.	450,7 co. ar.	7,34611
Is to radius	90	10,0000
So is A D	341,4	2,53326
To co-sine ang. D 50.45		9,87937
Subtract E. by N. 11.15		

Remains W. 29 30 N. for the ship's course from D, the easternmost port.

Sum E. 89 59 N. or N. the course from B, the westernmost ship's port.

CASE V.

The bearings of two or more places from two different stations, as also the bearings and distance of the said stations from each other being given, to find the bearings and distance of the said places from each other?

This case is a compound of the first and second cases.

EXAMPLE I.

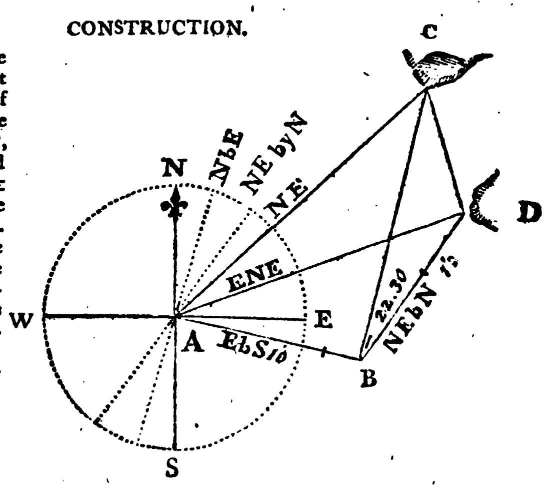
Coasting along shore, I saw two headlands, the first bore from me N. E. the second E. N. E. and after I had sailed E. by S. 10 miles, the first bore from me N. by E. and the second N. E. by N. I demand the bearings of the two headlands from each other?

CONSTRUCTION.

1st Having drawn the compass N. E. S. W. let A represent the place of the ship, from whence draw the N. E. line A C, the E. N. E. line A D, and the E. by S. line A B = 10 miles, then will B be the ship's second station.

2d. From B draw the line B C parallel to the N. by E. where this intersects the N. E. line as in C, gives the first headland.

3d. Also from B draw the line B D parallel to the N. E. by N. where this intersects the E. N. E. line, as in D, gives the second headland.



4th. Join the points C and D, then will C D be the distance of the headlands from each other, and the ∠ A C D their bearing from the N. E. line, to find which by

Calculation

CALCULATION,

First you must find the distance of both headlands from both stations.

1. In the △ ABC all the ∠s are given, and one side AB 10 miles.

Betwixt E. by S. and N. by E. are eight points, consequently, the ∠ ABC is right-angled.

Betwixt N, E. and E. by S. is 5 points, or ∠CAB = 56° 15′. Its comp. ∠ A C B = 33° 45′. In △ ACB.

As sine ∠ ACB = 33° 45′ co. ar. 0,25526
: sine AB = 10 1,00000
: : sine ∠CAB = 56 15 9,91985

BC 14.97 1,17511
or 15 miles nearly.

2. In the △ A D B.

Betwixt E. N. E. and E. by S. are 3 points = ∠DAB 33° 45′.

Betwixt E. N. E. and N. E. by N. is 3 points, so that the ∠ ADB is = 33 45′; now there are 2 ∠s equal, consequently there must be two sides equal, viz. the sides opposite those angles, that is, the side AB = the side BD = 10 miles; and the △ ABD is an isocles △.

180
22 30

2)157 30

78 45

Lastly, In the △ CBD is given the side CB 14,96, the side BD 10 miles, and ∠CBD.

For betwixt the N. by E. and N. E. by N. is 2 points, or the ∠CBD = 22° 30′.

As sum of sides BC & BD = 24,97 8.60258
: diff. sides BC & BD 4,97 0.69636
: : tang. ½ sum opp. ∠s = 78° 45′ 10,70134

tang. ½ difference 45 2 10,00028
∠ CDB 123 43

∠ BCD 33 43

As sine ∠BCD 33 43 0,25564
: to BD 10 0 1,00000
: : sine ∠CBD 22 30 9,58284

: C D the distance of both 68,9 1,8388

Again,
from ∠ B C D = 33 43
Subtract N. by E. 11 15

22 28 that is D bears from C. S. 22 28 E. or S. S. E. and C the contrary from D.

THE MANNER OF SURVEYING COASTS AND HARBOURS.

To take the Draft of a Coast in Sailing along it.

HAVING brought the ship to the most convenient place from whence the principal points of the Coast or Bay may be seen, either cast anchor, if it is convenient, or lie as steady as possible; or, if the coast is too shoal, let the observations and measures be done in a boat; then, while the vessel is in a stationary situation, take with the azimuth compass, or sextant, the bearings in degrees, &c. of such points of the coast as form the most material projections or hollows; write down these bearings, and make a rough sketch of the coast, observing carefully to mark the points whose bearings were taken with letters, for the sake of reference.

Then let the ship or boat run in a direct line along, which must be carefully measured by the log, or otherwise, one, two, or three miles, more or less, until she comes to a situation from whence the same points before observed can be seen again: there let the vessel lie as in the foregoing station, and again observe the respective bearings and leading-marks where two points or bearings, as mountains, churches, trees, and houses, any two remarkable objects in one, in degrees, &c. of the same noted points, which are also to be wrote down, and a rough sketch of the coast should be also taken

from

from this ftation, for which purpofe prepare an obfervation table, in which write diftinctly and regularly the feveral celeftial obfervations, bearings, diftances, meafured by the log-line, the rocks, fhoals, foundings, overfalls, races of tides, and other remarks that may be made along the coaft; the table may confift of 7 or 8 columns difpofed in the following order:

NOTE.—The fextant will be found the readieft and moft correct inftrument to take the angles, by being held in an horizontal pofition, by which means any two objects, not exceeding 120°, may be brought into contact; it will not be amifs to take material points by the compafs, and intermediate ones by the fextant or quadrant.

Obfervations in navigating the Coaft —— from Cape —— to Point ——, being —— Miles, meafured by the Log, the Cou. from Station 1 to 2, being S. ¼ W.

Year, Month and Day.	Sun's Mer. Alt.	Bearings at ftation. 1	Time and diftance failed from ftation. 1		Bearings and diftances taken at thefe diftances.		Bearings of rocks, fhoals, and their eftimated diftance when on a line with a point or heads of the coaft.	Remarks on the tides, nature, and dimenfions of rocks, fhoals, and anchorage.
	D.M.		H.M.	Miles		Fath.	Points and heads. M.	
			1. 27 11.45	¼ 5	A.N.5°W. B.W.20°S.	22		This rock dries and feemed 100 yds. N.&S. a leading mark to it is

While the veffel is running the bafe line from ftation to ftation, an accurate appearance of the coaft fhould be made, to do which, let four expert perfons be appointed, one to take the bearing exactly with an azimuth compafs; one to overfee the running out of the log-line, and to keep an account of the fhip's way, fo as to be readily able to tell the diftance run when required; the third to attend the heaving of the lead, to write down the foundings and bearings of one or two head points, or remarkable points of the coaft, taken at each depth; the fourth a draftfman, to draw out the neceffary bearings and diftances, and delineate the figures and windings of the coaft at each ftation, and to correct their forms and dimenfions when the fhip is failing along the land. Then let the feveral bearings be corrected by the variation to reduce them to their true pofitions; then, in fome convenient part of a fheet of paper, defcribe a circle, the larger the better, on which lay off the feveral bearings taken from the firft ftation, and let them be numbered 1, 2, 3, &c. on the outfide of the circle; alfo lay down the feveral bearings taken at the 2d ftation, let thefe be numbered with the fame figures on the infide of the circle.

Draw

Draw a line to expreſs the ſhip's run, both in length and courſe, and from the end of the line, expreſſing the firſt ſtation, draw lines parallel to the reſpective bearings taken at that end, and note it in the circle; mark the interſections of each pair of lines, directed to the ſame point, with the numbers annexed to their bearings; and, through the interſections ſo marked, draw by hand a curved line; obſerve to wave the line in and out as near as can be like the bending of the coaſt itſelf.

Againſt each part draw the appearance of the elevated, or low ground, in the ſketches, diſtinguiſhing rocks, cliffs, or high lands, low lands, ſand hills, &c. If there are any currents or eddies, expreſs them in their proper places, by darts or arrows, the points being turned that way the currents ſet; put in the ſeveral ſoundings at low water, in ſmall figures, diſtinguiſhing whether fathoms or feet; ſhew the time of high water on the full and change days, by Roman figures, and tell the riſe in feet, put in a compaſs with a ſcale of miles or leagues, ſuch as the veſſels run was laid down by; add the name of the place, the coaſt, and the latitude and longitude, as true as can be obtained.

If there is a ſhoal or ſand on the coaſt, let it be taken by a boat ſailing round it, and keeping an account of the courſes, diſtances, and ſoundings, to be put in the draft; the boat muſt, from ſome part of the ſaid ſand or ſhoal, take the bearings of two points of the coaſt, where bearings have been taken from the ſhip, or the bearing of the boat, or ſome part of the ſhoal, or ſome beacon in that place muſt be taken by the ſhip, at the ſtations where ſhe takes the bearings of the ſhore; for, by either of theſe means one point of the ſand being obtained, the reſt of it can be laid down from the boat's account.

If the coaſt to be drawn is a bay or harbour, winding in ſuch a manner that all its parts cannot be ſeen at two ſtations; let as many baſes or lines be drawn, and exactly meaſured, as may be found neceſſary, obſerving that the ſeveral diſtances run ſhould join to one another, in the nature of a traverſe; that each new ſet of objects or points obſerved ſhould be taken from two ſtations at the end of a known diſtance, and that the objects whoſe bearings are taken do not ſo much extend beyond the limits of the baſe, as to make angles with it leſs than about ½ or ¾ of a point, but rather reſerve ſuch objects for the next meaſured baſe line; for when lines lie very obliquely to one another, their interſections are not eaſily aſcertained.

Thus may a coaſt of any extent be ſurveyed, by carefully meaſuring of ſtationary baſe lines, and from their ends drawing angles to each other.

If any particular parts of the harbour cannot be conveniently ſeen from either ſtation, take the boat into thoſe places, and, having well examined them, make ſketches thereof, eſtimating the length and breadth of the ſeveral inlets, either by the rowing or ſailing of the boat; take as many bearings, ſoundings, and other notes, as

may

may be thought neceſſary; then annex theſe particular views in their proper places in the general draft.

If there are any dangerous ſands or rocks, beſides inſerting them in their proper places, there ſhould be a double line drawn through that point, on one or more objects aſhore; and for this purpoſe chooſe a church, mill, houſe, noted tree, a clift, or any remarkable thing that can be diſtinctly ſeen at ſea, and which can be brought to bear in the ſame right line with the point to be avoided; but if that point is under water, there muſt be two land-marks brought to bear with the danger, either in a right line, when it can be, or in two lines, and thoſe two lines, and thoſe land marks may be put down in their proper places, by their interſection of two objects in one bearing, and two objects in another bearing; which will give the ſtation of the ſhip, and the diſtance and the bearing of the danger from that ſtation, noted when near or on it; but if two ſuch interſections cannot be obtained, it muſt be put down from the two points on ſhore, in one with the computed diſtance therefrom, or from the interſecting bearings of two ſingle points on ſhore.

It ſhould be remarked in the draft, what places, if any, are unfit for anchorage, and what are fit, by writing rocky ground, foul anchorage, good anchorage; and in the latter to draw the figure of an anchor. Alſo, if there is any particular channel more convenient to ſail through than another, it is to be pointed out by lines drawn to its entrance, from two or more noted marks on ſhore.

The foregoing method of ſurveying a coaſt, ſuppoſes in general, that it is taken by a ſhip in her paſſage along, not having an opportunity of going aſhore. But when circumſtances will permit the meaſures and obſervations to be made on land, the ſurvey can be more accurately taken than on the water.

To Survey an Harbour by Obſervation aſhore.

MAKE an eye-draft of the place to be ſurveyed; and, in going round its coaſt, fix in the moſt remarkable points and bends of the ſhore ſtation ſtaves or ſtrait poles, tall enough to be ſeen at a conſiderable diſtance; but if at any of thoſe places there is a noted tree, houſe, or any other remarkable thing, that object may ſerve inſtead of a ſtation ſtaff; and it will be convenient to black the ſtaves, and tie a piece of white bunting to the top of each; then, in the eye-draft, put letters at the noted points, or marks, for diſtinction-ſake.

Chooſe the moſt level ſpot of ground, wherein a baſe line may be meaſured, of one or more half miles in length, or a length of not leſs than a tenth part of the diſtance of the two extreme objects marked for obſerving, and let the direction of the meaſured baſe line be ſo laid out, that from both ends of it as many of the ſtation ſtaves before planted, or the objects before remarked, may be ſeen; the bearing or poſition of this baſe muſt be determined by degrees

 and

and minutes, and also its length must be accurately measured to feet and parts, either by a measuring chain, or by a piece of log-line of 100 feet long, properly marked at the end of every 10 feet.

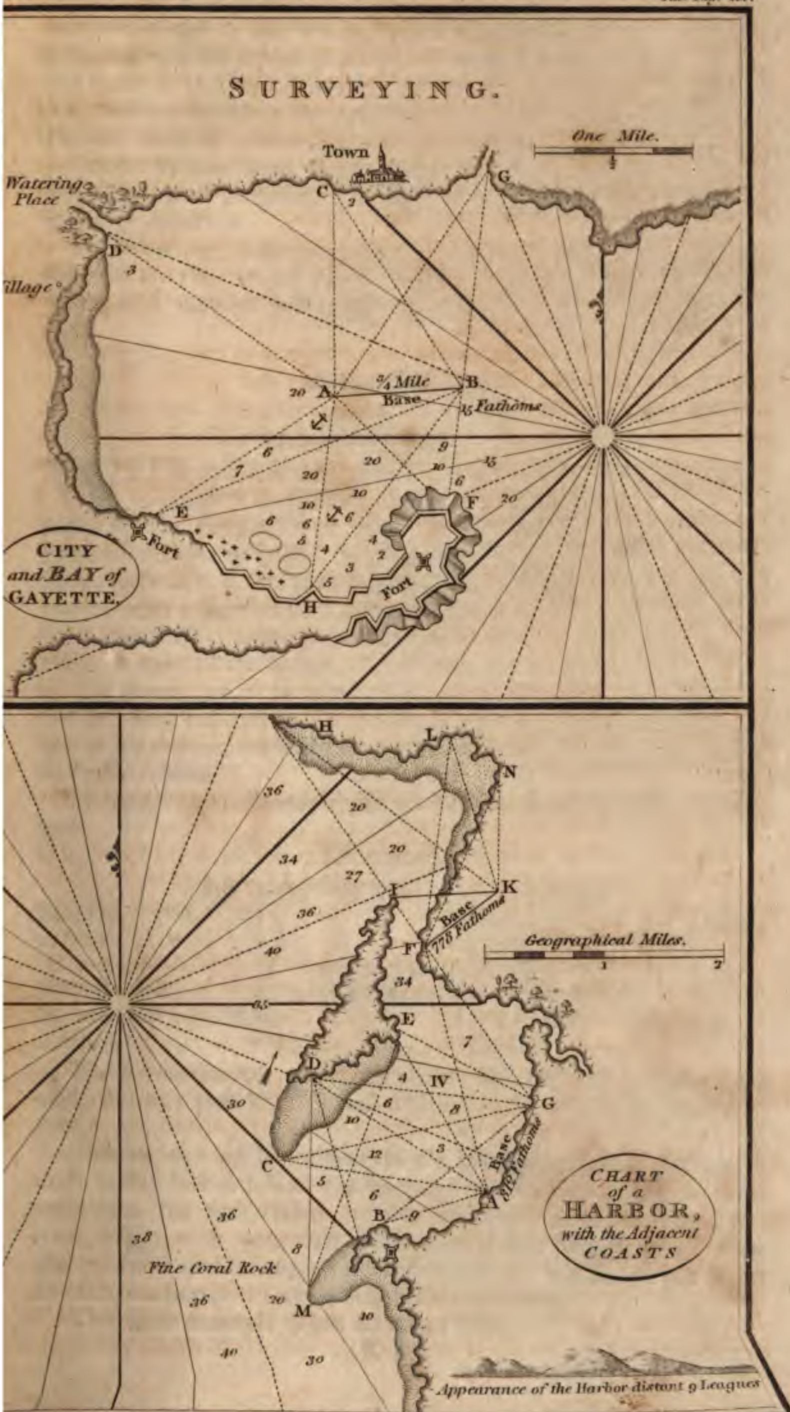
From one end of the base observe, with any instrument proper to take bearings, the position or bearing in degrees and minutes of all the staves or objects within view, and write them down orderly; do the same from the other end of the base, and let all the bearings be corrected by the variation of the compass.

Then these measures and corrected bearings being plotted or laid down, will give the most conspicuous points on shore, the intermediate spaces are to be filled up from the sketches of them made on the spot.

But if any such objects should spread on either hand, so far from beyond the limits of the base, that at either end thereof, the other end and those objects or staves should appear nearly in the same direction, or to make <s of, not exceeding 10°: or, if some of the remarked objects can be seen only from one end of the base, then let the bearings of such objects be taken from a place whose position has been determined from both ends of the measured base; or if there are several remarked objects which cannot be seen from either end of the base lines, let the bearings of such objects be taken from each of the two points whose position has been taken from both ends of the base; or, it may on some occasions be proper to choose another place on which another base of a convenient length may be measured, and from the extremities of which the ends of the first base may be seen, and also as many as can be of the remaining objects which lay too obliquely for the first base, or which could not be seen from it; in such manner proceed until the bearings are taken of all the points judged necessary for completing the survey of the limits of the harbour.

If a base line of a sufficient length cannot be measured in one right line, it may be taken in two adjoining lines, as the two sides of a triangle, the included angle being accurately taken, and the bearing of either line.

When the outlines or limits of an harbour, bay, road, &c. are delineated by the preceding precepts, let a small vessel go out to sea to take drawings of the appearance of the land, and its bearings, sail likewise into the harbour, and draw the appearance of its entrance; take particular notice if there are any false resemblances of the entrance by which ships may be deceived and run into danger; or when any two objects being brought in a line, or in one, will lead into the harbour without danger; when it can be done, search for the best anchoring places, and if possible denote those places, by bringing two objects in one, if not the exact bearings of two or three other objects, so that the places may be easily determined, the chart being correctly drawn, a compass with the variation, and scale properly fitted to the plan, the isles, rocks, sands, &c. marked in their proper places, with their soundings at low water, and the winds open to them, the best tract with the sound-


SURVEYING.
One Mile.
Town
Watering Place
Village
¾ Mile Base
15 Fathoms
Fort
Fort
CITY and BAY of GAYETTE.
Geographical Miles.
Base 778 Fathoms
Base 812 Fathoms
Fine Coral Rock
CHART of a HARBOR, with the Adjacent COASTS
Appearance of the Harbor distant 9 Leagues

Penny sculp.

ings all the way to thoſe anchoring places, the proper ſailing marks to avoid dangers; the winds, if any troubleſome ones, which prevail, and at what ſeaſons; the places where freſh water can be got, the name of the place, the country in, on what ſea, the latitude and longitude, a ſketch of the appearance the place makes at ſea upon a known rhumb, and at an eſtimated diſtance, and whatever elſe a judicious ſeaman ſhall think proper to inſert; then is the plan fit for all nautical purpoſes, and may be embelliſhed with proper colours, if neceſſary.

Sea-drawings, taken according to the foregoing precepts, beſides the real uſe they are of, cannot fail to recommend the young mariner who ſurveys and conſtructs them, to the notice of his ſuperiors.

To reduce a Draft to a ſmaller Scale.

WITH a black lead pencil draw the draft to be reduced all over with croſs-lines, forming exact ſquares, draw the clean paper for the copy all over with the ſame number of ſquares, but their ſides larger or ſmaller in proportion to the intended ſize of the ſcale, ſuch as $\frac{1}{2}$, $\frac{1}{4}$, &c. length of the other, diſtinguiſh by a ſtronger mark, with a figure every fifth or ſixth row of ſquares in both, ſo that the ſeveral correſponding ſquares may be readily perceived; then, in each of the ſquares of the draft, draw, by the eye, a curve on the paper, ſimilar to that in the ſquare of your copying draft, till the whole is copied; make the black lines with India or other ink, and when drawn, the black-lead lines may be rubbed out with bread or India rubber.

I here give two Examples, as an elucidation of what has laſt been ſaid.

EXAMPLE I.

AB is the baſe line, equal to $\frac{3}{4}$ Mile.

BG=N. 5° E.	1	Station at B, with Bearings.	AG=N. E. by N.	1	Station at A with Bearings.
BC=N. 25 W.	2		AC=N.	2	
BD=N. 53 W.	3		AD=N. 53° 25′ W.	3	
BE=W. S. W.	4		AE=S. W. by W.	4	
BH=S. W. by S. $\frac{1}{2}$ W.	5		AH=S. $\frac{1}{2}$ W.	5	
BF=S.	6		AF=S. E.	6	

Theſe inſtruments give the points GC DE HF in order from each ſtation; that is, BG and AG interſect, as alſo BC and AC, &c.

Obſerve, the laſt letter muſt be the ſame in both bearings, and it will be the beſt to follow the bearings one way all round the compaſs from the firſt ſtation; as alſo when arrived at the ſecond ſtation, begin with your firſt object ſeen at firſt ſtation, and follow the letters round belonging to each object, by which the laſt letter in each bearing will ſucceſſively follow in order.

This is an example when on board ſhip.

EXAMPLE II.

This harbour was ſurveyed by baſe lines taken on ſhore, which, when it can be done, is far preferable.

The baſe line AG 812 fathoms, was taken, as by directions, on the moſt even ſpot on ſhore; now, beginning from the point A:

AB=W. by S. $\frac{1}{2}$ S.	Bearings from Station A.	GB=S. S. W.	Bearings from Station G.
AC=W. by N.		GC=W. by S. $\frac{1}{4}$ S.	
AD=W.N.W.$\frac{3}{4}$N.		GD=W. $\frac{3}{4}$ N.	
AE=N.N.W.$\frac{3}{4}$W.		GE=W.N.W.N.	
AF=N. by W.$\frac{1}{2}$W.		GF=N.W.by N.$\frac{1}{4}$N.	
AG=N. N. E.	812 fath.		

After having made theſe obſervations, it will be neceſſary to proceed to the northern part of the coaſt. In all caſes where a coaſt is ſurveyed in ſeveral parts, it is moſt adviſable to meaſure a new fundamental baſe for each part, when it can be conveniently done. A line meaſured from the ſtation F, towards K, is well adapted to our purpoſe. Let FK, therefore, be the ſecond baſe line; its length, by admeaſurement, is found to be 778 fathoms; and its bearing, by compaſs, N. E. $\frac{1}{4}$ E. Take bearings from each end of this baſe as before.

FI and FH=N.W.by N.$\frac{1}{4}$N.	Bearings from Station F	KF=S.W.$\frac{1}{4}$W.	Bearings from Station K.
FL=N. $\frac{1}{4}$ E.		KH=N.W.$\frac{1}{4}$N.	
FK=N.E.$\frac{1}{4}$E.778 fath.		KI=W.$\frac{1}{2}$S.	
		KL=N.by W.	
		KN=N.$\frac{1}{4}$E.$\frac{1}{2}$W.	

It is plain, that the connection between the two parts of this ſurvey is preſerved by the ſecond fundamental baſe being drawn from the point F, whoſe ſituation was before determined by obſervations from the firſt baſe line. If this particular poſition of the firſt baſe line had not been convenient, and it had been taken at a diſtance from every point determined in ſituation from the firſt baſe line, the connection would have required an obſervation of the bearing of one of the ſaid points from each end of the ſecond baſe. Thus, ſuppoſe the line IK to be the ſecond baſe line, inſtead of FK, the poſition of IK, with reſpect to the given point F, may be known by taking the bearing of F from I and K.

The end of the ſhoal, marked M, lies with D, bearing N. and E. N. by E. $\frac{1}{2}$ E.

All the obſervations which are required to be made on ſhore being completed, through the interſections of the bearings draw the configuration of the coaſt, as before directed, and finiſh the drawing by the inſtructions there given; which, if well attended to, no difficulty can well occur.

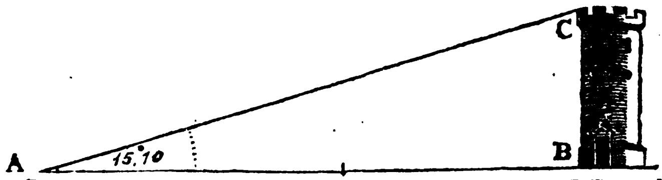
To find the Height and Diſtances of Objects at Sea.

WHEN the object is perpendicular, and the diſtance to it can be meaſured, find the angle of altitude with a quadrant, and meaſure the diſtance to it as exact as poſſible, and then you have the

the angles and bafe, to find the perpendicular; or, if you go backward or forward until the angle of altitude be 45°, the diftance between you and the object will be the perpendicular height.

EXAMPLE I.

Being 69 fathoms from the bottom of a tower, I find its altitude, after allowing for the height of my eye, above the water 15° 10′. Required the height?

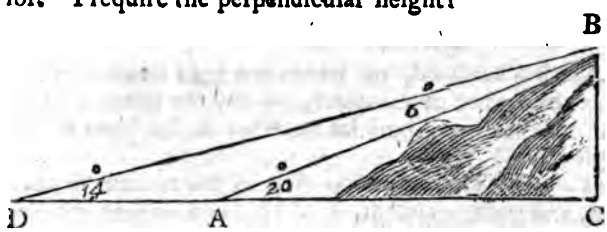


Draw AB=96, upon B erect the perpendicular BC, and draw AC, making an angle with AB=15° 10′ till it cuts BC in C, then will BC be the height of the tower. Or,

As radius	10.00000	As co-fi.ang.Aco.ar.
Is to the bafe 96	1.98227	: Bafe 96
So is tang. ang. A. 15° 10′	9.43308	:: S. ang. A.
To the height BC 26.2	1.41535	: the perpen.

EXAMPLE II.

Being at fea, I obferved the altitude of a mountain, and found it 20°, and then failing from it in a direct line four miles, I found the altitude of the mountain to be 14°, dip and refraction allowed for. I require the perpendicular height?



CONSTRUCTION.

Draw the horizontal line DC.

On any point A make the ∠BAC=20°, from A fet off four miles to D, on D make the ∠BDC=14°, and from where the line DB cuts the line AB as at B, let fall the perpendicular BC on the bafe, DC, and BC meafured will be the perpendicular height required.

		180 0
The angle BAC	—	20 0
The ang. BAD =		160 0
The ang. ADB =		14 0
		174 0
		180 0
The angle ADB =		6 0

As fine ∠DBA=6° 0′	co. ar.	0 98077
: AD=4 miles.		0.60206
:: Sine ∠BDA 14°		9.38368
: AB=9.258	=	0.96651

Then △ ABC given AB=9.258 and ∠ A find BC.

Radius	10.00000
: AB 9.258	0.96651
:: Sine ∠ 20	9.53405
: BC=3.166	0.50056

So that the height of the mountain is 3 miles $\frac{166}{1000}$ = 1 furlong, 13 poles, &c.

NOTE. In finding the > DAB see Prob. 5th in Geometry.

Of the Curvature of the Earth.

MOST perſons know that if they are raiſed above the ſurface of the adjacent land or water, they can not only ſee different objects that lie on that ſurface better, but alſo ſee thoſe more and more remote as they advance higher. The irregularity of the ſurface of the land will not be ſubjected to any one rule that will give the diſtance to which objects may be ſeen at different elevations; but at ſea, where there is generally an uniform curvature of the water, upon the ſuppoſition of the ſpherical form of the earth, thoſe diſtances may be eaſily computed.

RULE.

To the earth's ſemi-diameter add the height of the eye, multiply the ſum by the height, then the ſquare root of the product is the diſtance at which an object on the ſurface of the water can be ſeen by an eye ſo elevated; and by this rule was Table XXI. computed, the diameter of the earth being taken at 41798117 feet, according to Sir Iſaac Newton's meaſures. This Table may be uſefully applied to eſtimate the diſtance of an object at ſea, the elevation of that object above its horizon being known.

EXAMPLE I.

Sailing towards a headland, on which is a light houſe elevated 600 feet above the ſurface of the water, we ſaw the lights at night juſt appear in the horizon; how far were we at that time diſtant from that light-houſe?

Look in Table XXIII. for 600 feet in the column marked height in feet, and right againſt it, in the column marked diſtance in miles, is 29.994. So that the diſtance may be reckoned about 30 miles.

EXAMPLE II.

Being in company with ſome merchants walking on a ſandy ſhore, on the look out for a veſſel which was expected, whoſe top-gallant maſt was 140 feet above the ſurface, allowance being made for her immerſion in the water, we obſerved through the teleſcope a ſhip's vane juſt appearing in the horizon. How far off is that ſhip, ſuppoſing it the veſſel expected? Anſwer, againſt 140 feet, the height, ſtands 14.488, that is her diſtance; here is no allowance made for the height of the eye above the horizon; but it is obvious, that the higher the eye, the farther it can ſee: now as objects are ſeen in a ſtrait line, and that line is a tangent to the earth's ſurface, therefore it follows, that to find the diſtance of two elevated

objects, when the right line joining them touches the surface of the earth, between those objects look for the distance answering each height, and their sum is the distance required.

Thus, in the second example, suppose the eye raised six feet above the water's edge, it can see an object on the surface 2.999, or three miles off. This distance added to 14 ½ miles, make the distance of the ship to be 17 ½ miles.

EXAMPLE III.

A man being on the main-top-gallant mast of a man of war, 200 feet above the water, sees a 100 gun ship she had engaged the day before hull-to; how far were those ships distant from one another?

A ship of 100 guns, or a first-rate man of war, is above 60 feet from the keel to the rails, from which deduct about 20, leaves 40 for the height of her quarter above water. Now a ship is seen hull-to when her upper works just appear.

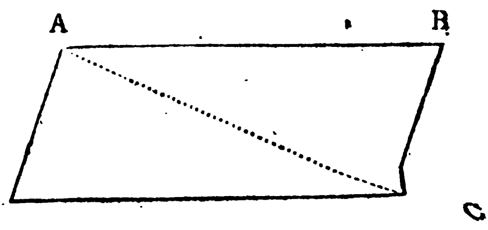
Then 200 feet high gives	17.316 miles.
And against 40 stands	7.744
	25.060 miles is her distance.

CURRENT SAILING.

CURRENTS are certain settings of the streams, by means of which all bodies moving therein are compelled to alter their course and submit to the motion impressed upon them by it: whence, if a current sets with the course of a ship, it augments her motion by as much as the drift or rate of driving it.

Thus, if a ship sails N. N. E. 20 miles, in a current that sets N. N. E. 8 miles, in the same time her true course will be N. N. E. 28 miles in that time; but if a current sets against a ship, it lessens her velocity by just as much as the current's drift is.

So that if the ship sails N. E. 49 miles, in a current that sets S. W. 10 miles in that time, then her true course will be N. E. 39 miles; and if in the same time that the ship sails N. E. 49 miles in a current that sets S. W. 59 miles, then the ship will fall a-stern, and her true course will be S. W. 10 miles; but if the ship thwarts the current, it not only lessens or augments her velocity, but gives her a new motion, compounded of that of the ship and current;



If a body be agitated by two motions at the same time, the one with a certain velocity that will carry it according to the direction of the line AB, the length AB in a certain space of time, the

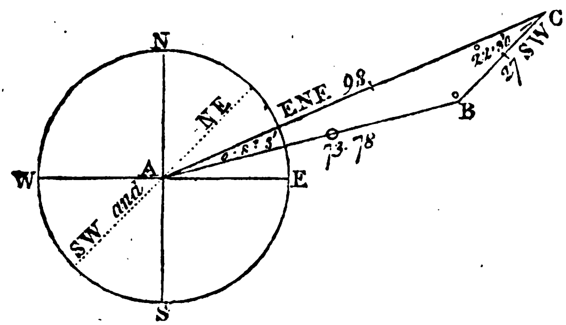
other according to the direction of the line AD, with a velocity that will carry it to the diftance AD in the fame time, then the body will defcribe the diagonal AC, and at the end of that time will be found in the point C.

The fetting and drifts of the moft remarkable tides and currents arepretty well known, but if in unknown currents, the ufual way to find the fetting and drift is thus:

Let three or four men take a boat a little way from the fhip, and, by a rope faftened to the boat's ftem, let down an heavy iron pot, or loaded kettle, into the fea, to the depth of 80 or 100 fathoms when it can be, whereby the boat will ride almoft as fteady as at anchor, then heave the log, and the number of knots run out in half a minute will give the miles which the current runs per hour, and the bearing of the log fhews the fetting of the current.

EXAMPLE I.

If a fhip fails E. N. E. 98 miles in a current that fets S. W. 27 miles in the fame time, what is her true courfe and diftance?



180° 0'
22 30

2)157 30

½ Sum of req. <s. 78 45

CALCULATION.

The oppofite point to S.W. is N. E. which taken from E. N. E. leaves 2 points=22° 30', between them for the < C.

Now we have in the △ ACB the fide AC, fide CB, and the < C given, to find the < A, < B, and fide AB=diftance by Axiom III.

Side	AC 98	As fum of the fides	125 co. ar.	7,90309
Side	BC 27	.. their diff.	71	1,85126
Sum of fides	125	:: tan. ½ fum of opp. <	78 45	10,70134
Diff.	71	.. tan. of ½ their diff.	70 42	10,45569

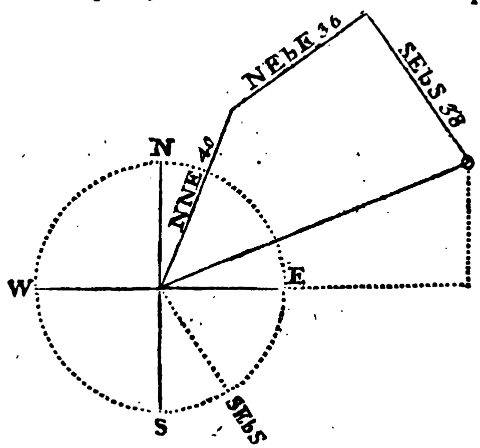
To

To ½ sum of the <s.	78° 45′	To find the dist. AB by axiom II.			
Apply the ½ diff.	70 42	As sine < A	8°	3′ co. ar.	0,85376
+ gives < B=	149 27	.. side BC	27		1,43136
− gives < A=	8 3	:: sine C	22	30	9,58284
		.. side AB	73	78	1,86796

The ∠ B 8° 3′+ E. N. E.=67° 30′=N. 75° 33′ E. the cou. and dist. 73,78 miles for the answer.

EXAMPLE II.

If a ship from the lat. 38° 40′ S. sails N. N. E. 40 miles, then N. E. by E. 36 miles, in a current that sets S. E. by S. 20 miles, in the same time that the ship sails 40 miles; I demand the distance from the first place, and also the latitude the ship is in?



CONSTRUCTION.

Having drawn the compass, draw the N. N. E. course equal to 40 miles, to the end of which join the N. E. by E. line, and set off thereon 36 from the same scale, from the end of the last N. E. by E. line set off the dist. of the current's drift, viz. S. E. by S. 38 miles, that is, as 40 the run of the ship is to 20 the run of the current, so is 76 the whole run of the ship to 38 the drift of the current, then to the end of that line to the ship's first place, will be the distance, and the angle being measured will be the ship's course, and a line let fall from this last point on the parallel of the ship's first place, will give on that parallel the departure from her first meridian.

This may be done by calculation; but that being tedious, we shall omit it, and shew how it may be done by a traverse, in which we shall consider the current as a single course.

Courſes. Miles.	Northing.	Southing.	Eaſting.	Weſting.
N. N. E. 40	37.0		15.3	
N. E. by E. 36	20.0		29.9	
S. E. by S. 38		31.6	21.1	
	57.0	31.6	66.3	
	31.6			
	25.4			

To the lat. ſailed from 38° 40′ S. ſub. the diff. of lat. 25 miles N. leaves the lat. 38° 15′ S where the ſhip is arrived at.

To find the courſe.			To find the diſtance.		
As diff. lat. 25.4 co. ar.		8,59517	As ſine cou. 60° 3′ co. ar.		0,02970
.. rad.		0,00000	.. dep.	66 3	1,82151
:: dep. 66° 3′		1,82151	:: rad.	——	
.. tan. cou. 69° 3′		10.41668	.. diſt.	71	1,85121

Her diſtance from her firſt place is 71 miles.

EXPLANATION OF SEA TERMS.

ABACK. The ſituation of the ſails, when their ſurfaces are preſſed aft againſt the maſt by the force of the wind.

Abaſt. The hinder part of a ſhip, or towards the ſtern. It alſo ſignifies *farther aft* or *nearer to the ſtern*; as, the barricade ſtands ABAFT the main-maſt; that is, nearer to the ſtern.

Abaſt the beam denotes the relative ſituation of any object with the ſhip, when the object is placed in any part of that arch of the horizon which is contained between a line at right angles with the keel and that point of the compaſs which is directly oppoſite to the ſhip's courſe.

Aboard. The inſide of a ſhip.

A-board is the diſtance run by a ſhip on one tack: thus they ſay, *good board*, when a ſhip does not go to leeward of her courſe; *a ſhort board*, and *a long board*, according to the diſtance run.

Aboard main tack! The order to draw the lower corner of the mainſail down to the cheſtree.

About. The ſituation of a ſhip as ſoon as ſhe has tacked.

About ſhip! The order to prepare for tacking.

Abreaſt. The ſituation of two or more ſhips lying with their ſides parallel, and their heads equally advanced; in which caſe they are abreaſt of each other. ABREAST OF ANY PLACE means off or directly oppoſite to it.

Adrift. The ſtate of a ſhip broken from her moorings, and driving about without controul.

Afloat. Buoyed up by the water from the ground.

Afore. All that part of a ſhip which lies forward, or near the ſtem. It alſo ſignifies *farther forward*; as, the manger ſtands AFORE the fore-maſt; that is, nearer to the ſtem.

Aft. Behind, or near the ſtern of the ſhip.

After. A phraſe applied to any object in the hinder part of the ſhip, as the after hatchway, the after-ſails, &c.

A-ground. The ſituation of a ſhip when her bottom, or any part of it, reſts on the ground.

A-head. Any thing which is ſituated on that point of the compaſs to which a ſhip's ſtem is directed is ſaid to be a-head of her.

A-hull. The ſituation of a ſhip when all her ſails are furled, and her helm to the lee-ſide; by which ſhe lies with her head being ſomewhat inclined to the direction of the wind.

A-lee. The poſition of the helm when it is puſhed down to the lee-ſide.

All in the wind. The ſtate of a ſhip's ſails when they are parallel to the direction of the wind, ſo as to ſhake, or quiver.

All hands hoay! The call by which all the ſhip's company are ſummoned upon deck.

Aloft. As the maſt-heads, or any where about the higher rigging.

Along-ſide. Side-by-ſide, or joined to a ſhip, wharf, &c.

Along-ſhore. Along the coaſt; a coaſt which is in the ſight of the ſhore, and nearly parallel to it.

Aloof. Is diſtance. Keep aloof, that is, keep at a diſtance.

Amain. At once, ſuddenly: as, LET GO AMAIN!

Amidſhips. The middle of a ſhip, either with regard to her length or breadth.

To anchor. To let the anchor fall into the ground, for the ſhip to ride thereby.

Anchorage. Ground fit to hold a ſhip by her anchor.

The anchor is a cock-bill. The ſituation of the anchor when it hangs by the ſtopper at the cathead.

At anchor. The ſituation of a ſhip riding at her anchor.

An-end. The poſition of any maſt, &c. when erected perpendicularly. The top-maſts are ſaid to be AN-END when they are hoiſted up to their uſual ſtations.

Apeek. Perpendicular to the anchor, the cable having been drawn ſo tight as to bring the ſhip directly over it. The anchor is then ſaid to be APEEK.

Arm the lead. Apply a pully to the lower end.

Aſhore. On the ſhore. It alſo means A-GROUND.

Aſtern. Any diſtance behind a ſhip, as oppoſed to A-HEAD.

Athwart. Acroſs the line of a ſhip's courſe or keel.

Athwart-hawſe. The ſituation of a ſhip when driven by accident acroſs the fore-part of another, whether they touch or are at a ſmall diſtance from each other, the tranſverſe poſition of the former are principally underſtood.

Athwart the fore foot. When any object croſſes the line of a ſhip's courſe, but a-head of her, it is ſaid to be ATHWART HER FORE FOOT.

Athwart-ships. A direction across the ship from one side to the other.

Atrip. When applied to the anchor, it means that the anchor is drawn out of the ground, and hangs, in a perpendicular direction, by the cable or buoy-rope. The topsails are said to be ATRIP when they are hoisted up to the mast-head, to their utmost extent.

Avast! The command to stop, or cease, in any operation.

Awning. A shelter or screen of canvas, spread over the decks of a ship to keep off the heat of the sun. Spread the AWNING, extend it so as to cover the deck. Furl the AWNING, that is, roll it up.

Aweigh. The same as ATRIP.

To back the anchor. To carry out a small anchor a head of the large one, in order to prevent it from coming home.

To back astern, in rowing, is to impel the boat with her stern foremost, by means of the oars.

To back the sails. To arrange them in a situation that will occasion the ship to move a-stern.

To back and fill. Is to receive the wind sometimes on the foreside of the sail, and sometimes on the other, and is used when dropping a vessel up or down a river.

Bay. A place for ships to anchor.

To bagpipe the mizen. To bring the sheet to the mizen shrouds.

To balance. To contract a sail into a narrower compass, by tying up a part of it at one corner.

Ballast. Is either pigs of iron, stones, or gravel, which last is called single BALLAST; and their use is to bring the ship down to her bearings in the water, which her provisions and stores will not do. Trim the BALLAST, that is, spread it about, and lay it even. The BALLAST shoots, that is, it shifts, or runs over from one side of the hold to the other.

Bale. Bale the boat; that is, lade or throw the water out of her.

Under bare poles. When a ship has no sail set.

Barge. A carvel-built boat, that rows with ten or twelve oars.

Batten. A thin piece of wood. Batten down the hatches, is to nail BATTENS upon the tarpaulins, which are over the hatches, that they may not be washed off.

Bearing. The situation of one place from another, with regard to the points of the compass. The situation also of any distant object, estimated from some part of the ship, according to her situation: these latter bearings are either ON THE BEAM, BEFORE THE BEAM, ABAFT THE BEAM, ON THE LEE OR WEATHER BOW, ON THE LEE OR WEATHER QUARTER, A-HEAD, OR A-STERN.

Bear a-hand. Make haste, dispatch.

To bear in WITH THE LAND. Is when a ship sails towards the shore.

To bear off. To thrust or keep off from the ship's side, &c. any weight when hoisting.

To bear up or *away.* The act of changing a ship's course, to make her sail more before the wind.

Beat-down. Caulking every seam in her bottom.

Beating to windward. The making a progress against the direction of the wind, by steering alternately close-hauled on the starboard and larboard tacks.

To becalm. To intercept the current of the wind, in its passage to a ship,

ſhip, by any contiguous object, as a ſhore above her ſails, as a high ſea behind, &c. and thus one ſail is ſaid to becalm another.

Before the beam denotes an arch of the horizon comprehended between the line of the beam and line of the keel forward.

To belay. To faſten a rope, by winding it ſeveral times backwards and forwards on a cleat or pin.

To bend a ſail. Is to affix it to its proper yard or ſtay.

Between-decks. The ſpace contained between any two decks of a ſhip.

Bight of a rope. Any part between the two ends. BIGHT, a narrow inlet of the ſea.

Bilge. To break. The ſhip is BILGED, that is, her planks are broken in with violence.

Bilge-water. Is that which, by reaſon of the flatneſs of a ſhip's bottom, lies on her floor, and cannot go to the pump.

Binnacle. A kind of box to contain the compaſſes in upon deck.

Birth. The ſtation in which a ſhip rides at anchor, either alone or in a fleet; the due diſtance between two ſhips; and alſo a room or apartment for the officers of a meſs.

Bitts. Very large pieces of timber in the fore part of a ſhip, round which the cables are faſtened when the ſhip is at anchor. After BITTS, a ſmaller kind of BITTS, upon the quarter-deck, for belaying the running rigging to.

To bitt the cable. Is to bring the cable under the croſs-piece, and a turn round the bitt-head. In this poſition it may be either kept fixed or veered away.

Bitter. The turn of the cable round the bitts.

Bitter-end. That part of the cable which ſtays within-board round about the bitts when the ſhip is at anchor.

Block. A piece of wood with running ſheaves or wheels in it, through which the running rigging is paſſed, to add to the purchaſe.

Block and block. When they cannot approach any nigher.

Board-and-board. When two ſhips come ſo near as to touch each other, or when they lye ſide-by-ſide.

To board a ſhip. To enter an enemy's ſhip in an engagement.

Bold ſhore. A ſteep coaſt, permitting the cloſe approach of ſhipping.

Bolt-rope. The rope which goes round a ſail, and to which the canvas is ſewed.

Bonnet of a ſail. Is an additional piece of canvas put to the ſail in moderate weather to hold more wind. Lace on the BONNET, that is, faſten it to the ſail. Shake off the BONNET, take it off.

Boot-topping. Cleaning the upper part of a ſhip's bottom, or that part which lies immediately under the ſurface of the water; and paying it over with tallow, or with a mixture of tallow, ſulphur, reſin, &c.

Both ſheets aft. The ſituation of a ſhip ſailing right before the wind.

Bow-grace. A frame of old rope or junk, laid out at the bows, ſtems, and ſides of ſhips, to prevent them from being injured by flakes of ice.

Bow-line bridles. Lines made faſt to the cringles in the ſides of the ſails, and to which the bow-line is faſtened.

Bow-lines. Lines made faſt to the bridles, to haul them forward

when

when upon a wind, which being hauled tort, enables the ſhip to ſail nearer to the wind.

To Lowſe. To pull upon any body with a tackle, in order to remove it.

Bowſprit. A large piece of timber which ſtands out from the bows of a ſhip.

Boxhauling. A particular method of veering a ſhip, when the ſwell of the ſea renders tacking impracticable.

Boxing. It is performed by laying the head-ſails aback, to pay off the ſhip's head when got in the wind, in order to return the ſhip's head into the line of her courſe.

To brace the yards. To move the yards, by means of the braces.

To brace about. To brace the yards round for the contrary tack.

To brace ſharp. To brace the yards to a poſition, in which they will make the ſmalleſt poſſible angle with the keel, for the ſhip to have head-way.

To brace-to. To eaſe off the lee-braces, and round in the weather-braces, to aſſiſt the motion of the ſhip's head in tacking.

To brail up. To haul up a ſail by means of the brails.

Brails. A name to certain ropes belonging to the mizen, uſed to truſs it up to the maſt. But it is likewiſe applied to all the ropes which are employed in hauling up the after corners of the ſtay-ſails.

To break bulk. The act of beginning to unload a ſhip.

To break ſheer. When a ſhip at anchor is forced, by the wind or current, from that poſition in which ſhe keeps her anchor moſt free of herſelf and moſt firm in the ground, ſo as to endanger the tripping or fouling her anchor.

Breaming. Burning off the filth from a ſhip's bottom.

Breaſt-faſt. A rope employed to confine a ſhip ſideways to a wharf, or to ſome other ſhip.

To bring by the lee. See TO BROACH TO.

To bring to. To check the courſe of a ſhip when ſhe is advancing, by arranging the ſails in ſuch a manner as that they ſhall counteract each other, and prevent her from either retreating or advancing.

To broach to. To incline ſuddenly to windward of the ſhip's courſe againſt the helm, ſo as to preſent her ſide to the wind, and endanger her loſing her maſts. The difference between BROACHING TO, and BRINGING BY THE LEE, may be thus defined: ſuppoſe a ſhip under great ſail is ſteering ſouth, having the wind at N. N. W. then weſt is the weather-ſide, and eaſt the lee-ſide. If, by any accident, her head turn round to the weſtward, ſo as that her ſails are all taken a-back on the weather-ſide, ſhe is ſaid to BROACH TO. If, on the contrary, her head declines ſo far eaſtward as to lay her ſails a-back on that ſide which was the lee-ſide, it is called BRINGING BY THE LEE.

Broadſide. A diſcharge of all the guns on one ſide of a ſhip both above and below.

Broken-backed, or hog'd. The ſtate of a ſhip which is ſo looſened in her frame as to drop at each end.

Bulk-head. A partition.

Buoy. A floating conical caſk, moored upon ſhoals, to ſhew where the danger is; alſo uſed to anchors to ſhew where they lie.

Bunt-lines. Lines that come down from the top of the maſt to the foot

foot rope before the fail, and by which the bunt or belly of the fail is hauled up outwards.

By the board. Over the fhip's fide.

By the head. The ftate of a fhip when fhe is fo unequally loaded as to draw more water forward than fhe ought.

By the wind. The courfe of a fhip as nearly as poffible to the direction of the wind, which is generally within fix points of it.

Cap. A piece of wood fixed on the head of the maft, through which the next maft goes.

Capftan. An inftrument by which the anchor is weighed out of the ground, it being a great mechanical power and is ufed for fetting up the fhrouds, and other work where great purchafes are required.

To careen. To incline a fhip on one fide fo low down, by the application of a ftrong purchafe to her mafts, as that her bottom on the other fide may be cleanfed by breaming, and examined.

Cafting. The motion of falling off, fo as to bring the direction of the wind on either fide of the fhip, after it has blown fome time right a-head. It is particularly applied to a fhip about to weigh anchor.

To cat the anchor. Is to hook the cat-block to the ring of the anchor, and haul it up clofe to the cat-head.

Cat's Paw. A light air of wind perceived in a calm, fweeping the furface of the fea very lightly. A hitch taken on the lanyard of a fhroud, in which the tackle is hooked in fetting up the rigging, and for other purpofes.

Cat-harping. Short pieces of rope which connect the lower fhrouds together where the futtock fhrouds are faftened.

Caulking. Filling the feams of a fhip with oakum.

Centre. This word is applied to that fquadron of a fleet, in line of battle, which occupies the middle of the line; and to that column (in the order of failing) which is between the weather and lee columns.

Chains, or Channels. A place built on the fides of the fhip, projecting out, notched to receive the chain-plates, for the purpofe of giving them a greater angle.

Chain-plates. Are plates of iron faftened to the fhip's fides under the chains, and to thefe plates the dead eyes are faftened by iron ftrops.

Chapelling, or building a Chapel, is when a veffel on a wind, in little wind, is caught a-back, and turns round on her keel to the fame tack without ftarting either tack or fheet.

Chafing. When two things rub and injure each other.

Chafe. A veffel purfued by fome other.

Chafer. The veffel purfuing.

Cheerly. A phrafe implying heartily, quickly, cheerly.

To claw off. The act of turning to windward from a lee-fhore.

Clear is varioufly applied. The weather is faid to be CLEAR, when it is fair and open; the fea-coaft is CLEAR, when the navigation is not interrupted by rocks, &c. It is applied to cordage, cables, &c. when they are difentangled, fo as to be ready for immediate fervice. In all thefe fenfes it is oppofed to FOUL.

To clear the anchor. Is to get the cable off the flukes, or ftock, and to difencumber it of ropes ready for dropping.

Clear

Clear hawse. When the cables are directed to their anchors without lying athwart each other.

To clear the hawse. Is to take out either a crofs, an elbow, or a round turn.

Clenched. Made faft, as the cable is to the ring of the anchor.

Clew-down. To haul the yards down by the clew-lines.

Clew-lines. Are ropes which come down from the yards to the lower corners of the fails, and by which the corners or clews of the fails are hauled up.

To clew up. To haul up the clews of a fail to its yard by means of the clew-lines.

Clofe hauled. That trim of the fhip's fails, when fhe endeavours to make a progrefs in the neareft direction poffible towards that point of the compafs from which the wind blows.

To club haul. A method of tacking a fhip when it is expected fhe will mifs ftays on a lee fhore.

Coafting. The act of making a progrefs along the fea-coaft of any country.

Cockbill. See the anchor is

To coil the cable. To lay it round in a ring, one turn infide another.

Commander. A large wooden mallet to drive the fid into the cable when in the act of fplicing.

To come home. The anchor is faid to come home when it loofens from the ground by the effort of the cable, and approaches the place where the fhip floated at the length of her moorings.

Coming to. Denotes the approach of a fhip's head to the direction of the wind.

Courfe. The point of a compafs to which the fhip fteers.

Crank. The quality of a fhip, which, for want of a fufficient ballaft, is rendered incapable of carrying fail without being expofed to danger.

Creeper. A fmall iron grapnel ufed to drag in the bottom of rivers, &c. for any thing loft.

Cringle. A ftrand of fmall rope introduced feveral times through the bolt rope of a fail, and twifted, to which ropes are faftened.

To crowd fail. To carry more fail than ordinary.

Crow-foot. Is a number of fmall lines fpread from the fore parts of the tops, by means of the piece of wood through which they pafs, and being hauled taut upon the ftays, they prevent the foot of the topfails catching under the top rim; they are alfo ufed to fufpend the awnings.

Conning. The art of directing the helmfman to guide the fhip in her proper courfe.

To cut and run. To cut the cable and make fail inftantly, without waiting to weigh anchor.

Davit. A long beam of timber ufed to fifh the anchor. See FISH THE ANCHOR.

Dead water. The eddy water, which appears like whirlpools, clofing in with the fhip's ftern, as fhe fails on.

Dead lights. A kind of window-fhutter for the windows in the ftern of a fhip, ufed in very bad weather.

Dead wind. The wind right againft the fhip, or blowing from the very point to which fhe wants to go.

Dead eyes. Blocks of wood through which the lanyards of the fhrouds are reeved.

To deaden a ſhip's way. To impede her progreſs through the water.

Diſmaſted. The ſtate of a ſhip that has loſt her maſts.

Dog-vane. A ſmall vane with feathers and cork, placed on the ſhip's quarter for the men at the cun and helm, to direct them when the veſſel is nigh the wind.

Dog-watch. The watches from four to ſix, and from ſix to eight in the evening.

Doubling. Board, thicker than ſheathing, which being nailed to the bottom will ſtand caulking.

Doubling. The act of ſailing round or paſſing beyond a cape or point of land.

Doubling upon. The act of encloſing any part of a hoſtile fleet between two fires, or of cannonading it on both ſides.

Downhaul. The rope by which any ſail is hauled down; as the jibb down haul, &c.

To dowſe. To lower ſuddenly, or ſlacken.

To drag the anchor. To trail it along the bottom, after it is looſened from the ground.

To draw. When a ſail is inflated by the wind, ſo as to advance the veſſel in her courſe, the ſail is ſaid TO DRAW; and ſo TO KEEP ALL DRAWING is to inflate all the ſails.

Drift. The angle which the line of a ſhip's motion makes with the neareſt meridian, when ſhe drives with her ſide to the wind and waves when laying to. It alſo implies the diſtance which the ſhip drives on that line.

Driver. A large ſail ſet upon the mizen yard in light winds.

Driving. The ſtate of being carried at random, as impelled by a ſtorm or current. It is generally expreſſed of a ſhip when accidentally broken looſe from her anchors or moorings.

Drop. Uſed ſometimes to denote the depth of a ſail; as the foretopſail DROPS twelve yards.

To drop anchor. Uſed ſynonimouſly with TO ANCHOR.

To drop a-ſtern. The ſhip is ſaid to drop a-ſtern when, in company with others, ſhe does not ſail ſo faſt.

To drop down a river. Is done either by backing and filling, or with the kedge anchor.

Dunnage. A quantity of looſe wood, &c. laid at the bottom of a ſhip, to keep the goods from being damaged.

Ear-ring. A ſmall rope faſtened to a cringle in the head of the ſail, for the purpoſe of extending it along the yard. There are Ear-rings for each reef.

To eaſe, to *eaſe away*, or to *eaſe off*. To ſlacken gradually; thus they ſay, EASE the bowline; EASE the ſheet.

Eaſe the ſhip! The command given by the pilot to the helmſman, to put the helm a-lee, when the ſhip is expected to plunge her fore part deep in the water when cloſe-hauled.

To edge away. To decline gradually from the ſhore or from the line of the courſe which the ſhip formerly held, in order to go more large.

To edge in with. To advance gradually towards the ſhore or any other object.

Elbow in the hawſe. Is when a ſhip being moored, has gone round

upon the ſhifting of the tides, twice the wrong way, ſo as to lay the cables one over the other: having gone once wrong, ſhe makes a croſs in the hawſe, and going three times wrong, ſhe makes a round turn.

End-for-end. A reverſal of the poſition of any thing is turning it END-FOR-END. It is applied alſo to a rope that has run quite out of the block in which it was reeved, or to a cable which has all run out of the ſhip.

End-on. When a ſhip advances to a ſhore, rock, &c. without an apparent poſſibility of preventing her, ſhe is ſaid to go END ON for the ſhore, &c.

Enſign. The flag worn at the ſtern of a ſhip.

Entering-port. A large port in the ſides of three deckers, leading into the middle deck, to ſave the trouble of going up the ſhip's ſide to get on board.

Even keel. When the keel is parallel with the horizon.

Fack, or *Fake.* One circle of any cable or rope coiled.

Fag-end. The end of a rope fagged out. See WIPPING.

Fair wind. A term for the wind when favourable to a ſhip's courſe.

Fair-way. The channel of a narrow bay, river, or haven, in which ſhips uſually advance in their paſſage up and down.

Fall. Any rope that paſſes through two or more blocks.

To fall aboard of. To ſtrike or encounter another ſhip when one or both are in motion.

To fall a-ſtern. See DROP A-STERN.

To fall calm. Is when there is a ceſſation of the wind.

To fall down. See DROP DOWN.

Falling off. Denotes the motion of the ſhip's head from the direction of the wind. It is uſed in oppoſition to COMING TO.

Fall not off! The command to the ſteerſman to keep the ſhip near the wind.

Fathom. A meaſure of ſix feet.

To fetch way To be ſhaken or agitated from one ſide to another ſo as to looſen any thing which was before fixed.

Fid. A ſquare bar of wood or iron, with ſhoulders at one end; it is uſed to ſupport the weight of the topmaſt, when erected at the head of a lower maſt.

Fid for ſplicing A large piece of wood, of a conical figure, uſed to extend the ſtrands and layers of cables in ſplicing.

To fill. To brace the ſails ſo as to receive the wind in them, and advance the ſhip in her courſe, after they had been either ſhivering or braced a-back.

Fiſh. A large piece of wood. Fiſh the maſt, apply a large piece of wood to it to ſtrengthen it.

Fiſh-hook. A large hook by which the anchor is received from under the cat-head, and brought to the ſide or gunwale: and the tackle which is uſed for this purpoſe is called the fiſh-tackle.

To fiſh the anchor. To draw up the flukes of the anchor towards the top of the bow, in order to ſtow it, after having been catted, by means of the davit.

Flag. A general name for colours worn and uſed by ſhips of war.

Flat-aft. The ſituation of the ſails when their ſurfaces are preſſed aft againſt the maſt by the force of the wind. *To*

To flat in. To draw in the aftermoſt lower corner or clue of a ſail towards the middle of the ſhip, to give the ſail a greater power to turn the veſſel.

To flat in forward. To draw in the fore-ſheet, jibb-ſheet, and fore-ſtayſail-ſheet, towards the middle of the ſhip.

Flaw. A ſudden breeze or guſt of wind.

Fleet. Above five ſail of the line.

Floating. The ſtate of being buoyed up by the water from the ground.

Flood-tide. The ſtate of a tide when it flows or riſes.

Flowing-ſheets. The poſition of the ſheets of the principal ſails when they are looſened to the wind, ſo as to receive it into their cavities more nearly perpendicular than when cloſe hauled, but more obliquely than when the ſhip ſails before the wind. A ſhip going two or three points large has FLOWING SHEETS.

Fore. That part of a ſhip's frame and machinery that lies near the ſtem.

Fore-and-aft. Throughout the whole ſhip's length. Lengthways of the ſhip.

To fore-reach upon. To gain ground of ſome other ſhip.

Forecaſtle. The upper deck in the fore part of a ſhip.

To forge over. To force a ſhip violently over a ſhoal by a great quantity of ſail.

Forward. Towards the fore part of a ſhip.

Foul, As FOUL WEATHER, FOUL BOTTOM, FOUL GROUND, FOUL ANCHOR, FOUL HAWSE. As oppoſed to FAIR, we ſay FOUL WIND.

To founder. To ſink at ſea by filling with water.

Foxes. Two or more yarns twiſted together by hand.

To free. Pumping is ſaid to FREE the ſhip when it diſcharges more water than leaks into her.

To freſhen. When a gale encreaſes it is ſaid to freſhen.

To freſhen the hawſe. Veering out or heaving in a little cable to let another part of it endure the chafing in the hawſe-holes. It is alſo applied to the act of renewing the ſervice round the cable at the hawſe-holes.

Freſh-way. When a ſhip encreaſes her velocity ſhe is ſaid to get FRESH WAY.

Full. The ſituation of the ſails when they are kept diſtended by the wind.

Full-and-by. The ſituation of a ſhip, with regard to the wind, when cloſe-hauled; and ſailing ſo as to ſteer neither too nigh the direction nor to deviate to leeward.

To Furl. To wrap, or roll, a ſail cloſe up to the yard or ſtay to which it belongs, and winding a gaſket round it to keep it faſt.

Futtock-ſhrouds. Are ſhrouds which connect the lower and top maſt rigging together.

Gage of the ſhip. Her depth of water, or what water ſhe draws.

To gain the wind. To arrive on the weather ſide, or to windward, of ſome ſhip or fleet in ſight, when both are ſailing on a wind.

Gammon the Bowſprit. Secure it by turns of a ſtrong rope paſſed round it, and into the cut-water, to prevent it from topping.

Gangway. The entering place into a ſhip.

Garboard ſtreak. The ſtreak neareſt to the keel.

Gaſket. Foxes plaited together, and which they paſs round the ſails and yards, &c. to keep them faſt when they are furled.

To gather. A ſhip is ſaid to gather on another as ſhe comes nearer to her.

Giger. A block ſtrapt with a tail to it, on which is fixed a ſheave, which is hitched on the cable when heaving in; through the block is generally rove a whip, to hold on the cable.

Gimbleting. The action of turning the anchor round by the ſtock, ſo that the motion of the ſtock appears ſimilar to that of the handle of a gimblet, when employed to turn the wire.

Girt. The ſhip is girt with her cables when ſhe is too tight moored,

To give chaſe to. To purſue a ſhip or fleet.

Gooſe-wings of a ſail. The clues or lower corners of a ſhip's main-ſail or foreſail, when the middle part is furled or tied up to the yard.

Grappling-iron. A thing in the nature of an anchor, with four or ſix flukes to it.

Gratings. Are hatches made full of apertures.

Grave the ſhip. To burn off the filth from her bottom.

Gripe of a ſhip. That thin part of her which is faſtened to the keel and ſtem, and joined to the falſe ſtem.

Griping. The inclination of a ſhip to run to windward.

Groin in the cable. Is when the cable does not coil as it ought.

Grounding. The laying a ſhip a-ſhore, in order to repair her. It is alſo applied to running a-ground accidentally.

Ground-tackle. Every thing belonging to a ſhip's anchors, and which are neceſſary for anchoring or mooring; ſuch as cables, hawſers, tow-lines, warps, buoy-ropes, &c.

Ground-tier. That is, the tier which is loweſt in the hold.

Growing. Stretching out; applied to the direction of the cable from the ſhip towards the anchors; as, the cable GROWS on the ſtar-board bow.

Grummet. A piece of rope, laid into a circular form, and uſed for large boats' oars, inſtead of rowlocks, and alſo for many other purpoſes.

Gun-room. A diviſion of the lower deck, abaft, incloſed with net-work, for the uſe of the gunner and junior lieutenant, and in which their cabins ſtand.

Gunnel The large plank that runs along upon the upper part of a ſhip's ſide.

Guy. A rope fixed to keep any thing in its place.

Gybing. The act of ſhifting any boom-ſail from one ſide of the maſt to the other.

Halyards. The ropes by which the ſails are hoiſted, as the topſail halyards, the jibb halyards, &c.

To hail. To ſalute or ſpeak to a ſhip at a diſtance.

Handing. The ſame as furling.

To hand the ſails. The ſame as to FURL them.

Hand-over-hand. The pulling of any rope, by the men's paſſing their hands alternately one before the other, or one above another.

Handſomely. Gradually, as LOWER HANDSOMELY.

Handſpike. Bars made uſe of with a windlaſs.

Hank. Pieces of wood to attach ſtayſails to their ſtays.

Hank

Hank-for-hank. When two ſhips tack and make a progreſs to windward together.

Harbor. A ſecure place for a ſhip to anchor.

Hard a-lee. The ſituation of the helm, when puſhed cloſe to the lee ſide of the ſhip.

Hard a-weather. The ſituation of the helm, when puſhed cloſe to the weather ſide of a ſhip.

To haul. To pull a rope.

To haul the wind. To direct the ſhip's courſe nearer to the point from which the wind blows.

Hawſe. The ſituation of the cables before the ſhip's ſtem, when ſhe is moored with two anchors out from forwards. It alſo denotes any ſmall diſtance a-head of a ſhip, or the ſpace between her head and the anchors employed to ride her.

Hawſe-holes. The holes in the bows of the ſhip through which the cables paſs. Freſhen hawſe, veer out more cable. Clap a ſervice in the hawſe, put ſomewhat round the cable in the hawſe-hole to prevent its chafing. To clear hawſe, is to untwiſt the cables where the ſhip is moored, and has got a foul hawſe. Athwart hawſe is to be acroſs or before another ſhip's head.

Hawſer. A ſmall kind of cable.

Head-faſt. A rope employed to confine the head of a ſhip to a wharf or ſome other ſhip.

Headmoſt. The ſituation of any ſhip or ſhips which are the moſt advanced in a fleet.

Head-ſails All the ſails which belong to the foremaſt and bowſprit.

Head-ſea. When the waves meet the head of a ſhip in her courſe, they are called A HEAD SEA. It is likewiſe applied to a large ſingle wave coming in that direction.

Head-to-wind. The ſituation of a ſhip when her head is turned to the point from which the wind blows, as it muſt when tacking.

Head-way. The motion of advancing, uſed in oppoſition to STERN-WAY.

To heave. To turn about a capſtern, or other machine of the like kind, by means of bars, handſpikes, &c.

To heave a-head. To advance the ſhip by heaving-in the cable or other rope faſtened to an anchor at ſome diſtance before her.

To heave a peek. To heave in the cable, till the anchor is a-peek.

To heave a-ſtern. To move a ſhip backwards by an operation ſimilar to that of HEAVING A-HEAD.

To heave down. TO CAREEN.

To heave-in the cable. To draw the cable into the ſhip, by turning the capſtern or windlaſs.

To heave-in ſtays. To bring a ſhip's head to the wind, by a management of the ſails and rudder, in order to get on the other tack.

To heave out. To unfurl or looſe a ſail; more particularly applied to the ſtayſails: thus we ſay, looſe the topſails and HEAVE OUT the ſtayſails.

To heave ſhort. To draw ſo much of the cable into the ſhip, as that ſhe will be almoſt perpendicularly over her anchor.

To heave tigh or *taught.* To turn the capſtern round, till the rope or cable becomes ſtraitened.

To

To heave the capstern. To turn it round with the bars.

To heave the lead. To throw the lead overboard, in order to find the depth of water.

To heave the log. To throw the log overboard, in order to calculate the velocity of the ship's way.

To heave too. To stop the vessel from going forward.

Heave handsomely. Heave gently or leisurely.

Heave heartily. Heave strong and quick.

Heave of the sea. Is the power that the swell of the sea has upon a ship in driving her out, or faster on, in her course, and for which allowance is made in the day's work.

To heel. To stoop or incline to one side; thus they say TO HEEL TO PORT; that is, to heel to the larboard side.

Helm. The instrument by which the ship is steered, aud includes both the wheel and the tiller, as one general term.

Helm a-lee! A direction to put the tiller over to the lee-side.

Helm a-weather! An order to put the helm over to the windward side.

High-and-dry. The situation of a ship when so far run a-ground as to be seen dry upon the strand.

Hitch. To make fast.

To hoist. To draw up any body by the assistance of one or more tackles. Pulling by means of a single block is never termed HOISTING, except only the drawing of the sails upwards along the masts or stays.

Hold. Is the space between the lower deck and the bottom of a ship, and where her stores, &c. lie. To stow the hold, is to place the things in it.

To hold its own. Is applied to the relative situation of two ships when neither advances upon the other; each is then said TO HOLD ITS OWN. It is likewise said of a ship which, by means of contrary winds, cannot make a progress towards her destined port, but which, however, keeps nearly the distance she had already run.

To hold on. To pull back or retain any quantity of rope acquired by the effort of a capstern, windlass, tackle, block, &c.

Home. Implies the proper situation of any object; as, to haul HOME the top-sail sheets is to extend the bottom of the top-sail to the lower yard, by means of the sheets. In stowing a hold, a cask, &c. is said to be HOME, when it lies close to some other object.

Horse. A rope under the yards to put the feet on.

Hoy. A particular kind of vessel.

Hull of the ship. The body of it.

Hull-down. Is when a ship is so far off, that you can only see her masts.

Hull-to. The situation of a ship when she lies with all her sails furled; as in TRYING.

To hull a ship. To fire cannon-balls into her hull.

Hulk. A ship without masts or rigging; also a vessel to remove masts into or out of ships by means of sheers, from whence they are called sheer hulks.

Jack. The union flag.

Jaming. Particular method of taking a turn with a rope, &c.

Jeer-blocks. The blocks through which jeers are drove.

Jeers.

Jeers. The ropes by which the lower yards are ſuſpended.

Jibb. The foremoſt ſail of a ſhip, ſet upon a boom which runs out from the bowſprit.

Jib-boom. A ſpar that runs out from the bowſprit.

Jelly boat. Smalleſt boat on board.

Junk. Old cable, or old rope.

Jurymaſt. Any ſpar that is ſet up, when the proper maſt is carried away.

Keckled. Any part of a cable, covered over with old ropes, to prevent its ſurface from rubbing againſt the ſhip's bow or fore foot.

Kedge A ſmall anchor.

Keel. The principal piece of timber on which the veſſel is built.

Keel-haul. To drag a perſon backwards and forwards under a ſhip's keel, for certain offences.

To keep away. To alter the ſhip's courſe to one rather more large.

To keep full. To keep the ſails diſtended by the wind.

To keep hold of the land. To ſteer near to or in ſight of the land.

To keep off. To ſail off, or keep at a diſtance from the ſhore.

To keep the land aboard. The ſame as TO KEEP HOLD OF THE LAND.

To keep your luff. To continue cloſe to the wind.

To keep the wind. The ſame as TO KEEP YOUR LUFF.

Kentledge. What is put in the bottom of the veſſel to keep the ground tier from getting wet.

Kink. Is when a rope has too much twiſt.

Knees. Are pieces of timber which confine the ends of the beams to the veſſel's ſide.

Knippers. A large kind of plated rope, which, being twiſted round the meſſenger and cable in weighing, bind them together.

Knot. A diviſion of the log-line, anſwering, in the calculation of the ſhip's velocity, to one mile.

Knot. There are many ſorts; ſuch as overhand knot, wall knot, diamond knot, &c.

To labour. To roll or pitch heavily in a turbulent ſea.

Laden in bulk. Freighted with a cargo not packed, but lying looſe, as corn, ſalt, &c.

Laid-up. The ſituation of a ſhip when moored in a harbour, for want of employ.

Lanch-ho. Signifies to let go the top rope, when a top-maſt, or top-gallant-maſt, is fidded.

Land-fall. The firſt land diſcovered after a ſea voyage. Thus a GOOD LAND-FALL implies the land expected or deſired; a BAD LAND-FALL the reverſe.

Land-locked. The ſituation of a ſhip ſurrounded with land, ſo as to exclude the proſpect of the ſea, unleſs over ſome intervening land.

Lanyards of the ſhrouds, are the ſmall ropes at the ends of them, by which they are hove taught, or tight.

Larboard. The left ſide of a ſhip, looking towards the head.

Larboard-tack. The ſituation of a ſhip when ſailing with the wind blowing upon her larboard ſide.

Laſh. To bind.

Laying the land. A ſhip which increaſes her diſtance from the coaſt, ſo as to make it appear lower and ſmaller, is ſaid to LAY THE LAND.

Leading.

Leading-wind. A fair wind for a ſhip's courſe.

Leak. A chink or breach in the ſides or bottom of a ſhip, through which the water enters into the hull.

To leak. To admit water into the hull through chinks or breaches in the ſides or bottom.

Lee. That part of the hemiſphere to which the wind is directed, to diſtinguiſh it from the other part which is called to windward.

Leeches. Are the ſides of the ſails.

Leechlines. Are lines which haul up the leeches to the yard.

Lee-gage. A ſhip or fleet to leeward of another is ſaid to have the lee-gage.

Lee-lurches. The ſudden and violent rolls which a ſhip often takes to leeward, in a high ſea; particularly when a large wave ſtrikes her on the weather-ſide.

Lee of the ſhore. See UNDER THE LEE OF THE SHORE.

Lee-quarter. That quarter of a ſhip which is on the lee-ſide.

Lee-ſhore. That ſhore upon which the wind blows.

Lee-ſide. That half of a ſhip, lengthwiſe, which lies between a line drawn through the middle of her length and the ſide which is fartheſt from the point of wind.

To leeward. Towards that part of the horizon to which the wind blows.

Leeward ſhip. A ſhip that falls much to leeward of her courſe, when ſailing cloſe-hauled.

Leeward tide. A tide that ſets to leeward.

Lee-way. The lateral movement of a ſhip to leeward of her courſe; or the angle which the line of her way makes with a line in the direction of her keel.

To lie along. To be preſſed down ſideways by a weight of ſail in a freſh wind.

To lie to. To retard a ſhip in her courſe, by arranging the ſails in ſuch a manner as to counteract each other with nearly an equal effort, and render the ſhip almoſt immoveable, with reſpect to her progreſſive motion or headway.

Life-lines. For the preſervation of the ſeamen; they are hitched to the topſail lift and tye blocks.

Lifts. The ropes which come to the ends of the yards from the maſt heads, and by which the yards are kept ſquare or toped.

Limbers. Holes cut in the ground timbers to let the water come to the well.

Liſt incline. The ſhip has a liſt to port, that is, ſhe heels to larboard.

Lizard. A bight of a ſmall line pointed on a large one.

Log, and *Log-line.* By which the ſhip's path is meaſured, and her rate of going aſcertained. Log-board, on which is marked the tranſactions of the ſhip, and from thence it is copied into the log-book every twelve hours.

Loggerhead. A large iron ball, with a ſtern to it.

A long ſea. An uniform motion of long waves.

Look-out. A watchful attention to ſome important object or event that is expected to ariſe. Thus perſons on board of a ſhip are occaſionally ſtationed to look out for ſignals, other ſhips, for land, &c.

To looſe. To unfurl or caſt looſe any ſail.

To

To lower. To eaſe down gradually.

Luff! The order to the ſteerſman to put the helm towards the lee-ſide of the ſhip, in order to ſail nearer to the wind.

Magazine. A place where gunpowder is kept.

To make a board. To run a certain diſtance upon one tack, in beating to windward.

To make foul water. To muddy the water by running in ſhallow places, ſo that the ſhip's keel diſturbs the mud at bottom.

To make ſail. To increaſe the quantity of ſail already ſet, either by unreefing, or by ſetting others.

To make ſternway. To retreat or move with the ſtern foremoſt.

To make the land. To diſcover it from afar.

To make water. To leak.

To man the yards, &c. To place men on the yard, in the tops, down the ladder, &c to execute any neceſſary duties.

Marline. Small line to ſeize blocks in their ſtraps, &c.

Marline-ſpike. An inſtrument to ſplice with, &c.

Maſted. Having all her maſts complete.

Maſts. The upright ſpars on which the yards and ſails are ſet.

Maul. Large hammer to drive the fid of the topmaſt either in or out.

Mend the ſervice. Put on more ſervice.

Meſſenger. A ſmall kind of cable, which being brought to the capſtan, and the cable by which the ſhip rides made faſt to it, it purchaſes the anchor.

To middle a rope. To double it into two equal parts.

Midſhips. See AMIDSHIPS.

To miſs ſtays. A ſhip is ſaid to MISS STAYS, when her head will not fly up into the direction of the wind, in order to get her on the other tack.

Mizen-peek. The after end of the gaffs.

Monkey-blocks. Are on ſome topſail yards, to reeve buntlines in.

Mooring. Securing a ſhip in a particular ſtation by chains or cables, which are either faſtened to an adjacent ſhore, or to anchors at the bottom.

Mooring ſervice. When a ſhip is moored, and rides at one cable's length, the mooring ſervice is that which is in the hawſe hole.

Mouſe. A kind of ball or knob, wrought upon the collar of the ſtays.

Muſter. To aſſemble.

Narrows. A ſmall paſſage between two lands.

Neap-tides. The loweſt tides when the moon is at the firſt and third quarters.

Neaped. The ſituation of a ſhip left aground on the height of a ſpring-tide, ſo that ſhe cannot be floated till the return of the next ſpring tide.

Near, or *no near.* An order to the helmſman not to keep the ſhip ſo cloſe to the wind.

Nothing-off. A term uſed by the man at the cun to the ſteerſman, directing him not to go from the wind.

Nun-buoy. The kind of buoys uſed by ſhips of war.

Oakum. Old rope untwiſted and pulled open.

Oars. What boats are rowed with.

Offing. To feaward from the land. A fhip is in the offing, that is, fhe is to feaward, at a diftance from the land. She ftands for the offing, that is, towards the fea.

Off-and-on. When a fhip is beating to windward, fo that by one board fhe approaches towards the fhore, and by the other ftands out to fea, fhe is faid to ftand OFF-AND-ON fhore.

Offward. From the fhore; as when a fhip lies a-ground, and leans towards the fea fhe is faid to heel offward.

On board. Within the fhip; as, he is come on board.

On the beam. Any diftance from the fhip on a line with the beams, or at right angles with the keel.

On the bow. An arch of the horizon, comprehending about four points of the compafs on each fide of that point to which the fhip's head is directed. Thus, they fay, the fhip in fight bears three points ON THE STARBOARD-BOW; that is, three points towards the right-hand, from that part of the horizon which is right a-head.

On the quarter. An arch of the horizon, comprehending about four points of the compafs, on each fide of that point to which the fhip's ftern is directed.

Open. The fituation of a place expofed to the wind and fea. It is alfo expreffed of any diftant object to which the fight or paffage is not intercepted.

Open hawfe. When the cables of a fhip at her moorings lead ftrait to their refpective anchors, without croffing, fhe is faid to ride with an OPEN HAWSE.

Orlop. The deck on which the cables are ftowed.

Over-board. Out of the fhip; as, he fell over-board, meaning, he fell out of, or from the fhip.

Overhaul. To clear away and difentangle any rope; alfo to come up with the chafe; as, we overhaul her, that is, we gain ground of her.

Over-fet. A fhip is OVER-SET when her keel turns upwards.

Out-of-trim. The ftate of a fhip when fhe is not properly balanced for the purpofes of navigation.

Out-rigger. A fpar projecting from the veffel to extend fome fail, or to make a greater angle for a fhifting back-ftay, &c.

Palm. A piece of fteel when mounted, acts as a thimble for fewing canvafs.

Parcel a rope. Is to put a quantity of old canvafs round it before the fervice is put on.

Parcel a feam. Is to lay a narrow piece of canvafs over it after it is caulked, before it is payed.

Parliament-heel. The fituation of a fhip when fhe is made to ftoop a little to one fide, fo as to clean the upper part of her bottom on the other fide.

Parting. Being driven from the anchors by the breaking of the cable.

To pawl the capftern. To fix the pawls, fo as to prevent the capftern from recoiling, during any paufe of heaving.

To pay. To daub, or cover, the furface of any body with pitch, tar, &c. in order to prevent it from the injuries of the weather.

To pay away or *pay out.* To flacken a cable or other rope, fo as to let it run out for fome particular purpofe.

To

To pay off. To move a ſhip's head to leeward.

Peek. A ſtay-peek, is when the cable and the fore-ſtay form a line. A ſhort peek, is when the cable is ſo much in as to deſtroy the line formed by the ſtay-peek. To ride with the yards a-peek, is to have them topped up by contrary lifts, ſo as to repreſent a St. Andrew's croſs They are then ſaid to be a Portland.

Pendant. The long narrow flag worn at the maſt head by all ſhips of the royal navy. Brace pendants are thoſe ropes which ſecure the brace-blocks to the yard-arms.

Pendant broad. A broad pendant hoiſted by a commodore.

Pierced. A term for gun ports.

Pitching. The movement of a ſhip, by which ſhe plunges her head and after-part alternately into the hollow of the ſea.

To ply to windward. To endeavour to make a progreſs againſt the direction of the wind.

Point-blank. The direction of a gun when levelled horizontally.

Points. A number of plated ropes made faſt to the ſails for the purpoſe of reefing.

Poop. The deck next above the quarter deck.

Pooping. The ſhock of a high and heavy ſea upon the ſtern or quarter of a ſhip, when ſhe ſcuds before the wind in a tempeſt.

Portland yards. Are the lower yards lowered half way down and toped an end.

Portoiſe. The ſame as PORT LAST; TO RIDE A PORTOISE is to ride with a yard ſtruck down to the deck.

Port. Uſed for larboard, or the left ſide; alſo a harbour or haven.

Port. A name given on ſome occaſions to the larboard ſide of the ſhip; as, the ſhip heels to port, top the yards to port, &c.

Port the helm! The order to put the helm over to the larboard ſide.

Port-laſt. The gunwale.

Ports. The holes in the ſhip's ſides from which the guns are fired.

Preſs of ſail. All the ſail a ſhip can ſet or carry.

Preventer. An extra rope, to aſſiſt another.

Prizing. The application of a lever to move any weighty body.

Purchaſe. Any ſort of mechanical power employed in raiſing or removing heavy bodies.

Purchaſe. To purchaſe the anchor, is to looſen it out of the ground.

Pudding and dolphin. A large and leſſer pad made of ropes, and put round the maſts under the lower yards.

Quarters. The ſeveral ſtations of a ſhip's crew in time of action.

Quartering. When a ſhip under ſail has the wind blowing on her quarter.

Quoil. Is a rope or cable laid up round, one fake over another.

Raft. A parcel of ſpars laſhed together.

Raft-port. A port in a veſſel's bow or ſtern to take in ſpars or timber.

To raiſe. To elevate any diſtant object at ſea by approaching it: thus, TO RAISE THE LAND is uſed in oppoſition to LAY THE LAND.

To rake. To cannonade a ſhip at the ſtern or head, ſo that the balls ſcour the whole length of the decks.

Range of cable. A ſufficient length of cable, drawn upon deck before the anchor is caſt looſe, to admit of its ſinking to the bottom without any check.

Ratlines. The ſmall ropes faſtened to the ſhrouds, by which the men go aloft.

Reach. The diſtance between any two points on the banks of a river, wherein the current flows in an uninterrupted courſe.

Ready about! A command of the boatſwain to the crew, and implies that all the hands are to be attentive, and at their ſtations for tacking.

Rear. The laſt diviſion of a ſquadron, or the laſt ſquadron of a fleet. It is applied likewiſe to the laſt ſhip of a line, ſquadron, or diviſion.

Reef. Part of a ſail from one row of eyelet-holes to another. It is applied likewiſe to a chain of rocks lying near the ſurface of the water.

Reefing. The operation of reducing a ſail by taking in one or more of the reefs.

Reef-bands. Pieces of canvaſs, about ſix inches wide, ſewed on the fore part of ſails, where the points are fixed for reefing the ſail.

Reeve. To reeve a rope, is to put it through a block, and to unreeve it, is to take it out of the block.

Ribs of a ſhip. That is, the frame.

Rendering. The giving way or yielding to the efforts of ſome mechanical power. It is uſed in oppoſition to jambing or ſticking.

Ride at anchor. Is when a ſhip is held by her anchors, and is not driven by wind or tide. To ride athwart, is to ride with the ſhip's ſide to the tide. To ride hawſe-fallen, is when the water breaks into the hawſe in a rough ſea.

Riding. When expreſſed of a ſhip, is the ſtate of being retained in a particular ſtation by an anchor and cable. Thus ſhe is ſaid to RIDE EASY OR TO RIDE HARD, in proportion to the ſtrain upon her cable. She is likewiſe ſaid to RIDE LEEWARD TIDE if anchored in a place at a time when the tide ſets to leeward, and to RIDE WINDWARD TIDE if the tide ſets to windward: to RIDE BETWEEN WIND AND TIDE, when the wind and tide are in direct oppoſition, cauſing her to ride without any ſtrain upon her cables.

To rig. To put the ropes in their proper places.

Rigging. The ropes to rig with.

Rigging out a boom. The running out a pole at the end of a yard to extend the foot of a ſail.

To rig the capſtern. To fix the bars in their reſpective holes.

Righting. Reſtoring a ſhip to an upright poſition, either after ſhe has been laid on a careen, or after ſhe has been preſſed down on her ſide by the wind.

To right the helm. Is to bring it into midſhips, after it has been puſhed either to ſtarboard or larboard.

Ring-ropes. Several turns round the cable and through the ring to ſecure the cable.

Road. A place near the land where ſhips may anchor, but which is not ſheltered.

Robins. Small plaited yarns with eyes to faſten the ſails to the yards with.

Rolling. The motion by which a ſhip rocks from ſide to ſide like a cradle.

Rope-yarn. Is what the cordage and cables are made with.

Rough

Rough-tree. A name applied to any maft, yard, or boom, placed in merchant-fhips, or a rail or fence above the veffel's fide, from the quarter-deck to the forecaftle.

Round-houfe. A houfe built upon deck.

Rounding. Ropes ufed to put round the cable in the wake of the hawfe, or ftem of the fhip, to keep it from rubbing or chafing the cable.

Rounding-in. The pulling upon any rope which paffes through one or more blocks in a direction nearly horizontal; as, ROUND-IN the weather-braces.

Round-turn. The fituation of the two cables of a fhip when moored, after they have been feveral times croffed by the fwinging of the fhip.

Rounding-up. Similar to ROUNDING-IN, except that it is applied to ropes and blocks which act in a perpendicular direction.

To row. To move a boat with oars.

Rowfing. Pulling upon a cable or rope without the affiftance of tackles.

Rudder. The machine by which the fhip is fteered.

Rullock. The nitch in a boat's fide, in which the oars are ufed.

Run. The after part of the veffel under water.

Runner-pennant. The firft that is put over the lower mafts with a block in each end.

To run out a warp. To carry the end of a rope out from a fhip in a boat, and faftening it to fome diftant object, fo that by it the fhip may be removed by pulling on it.

To fag to leeward. To make confiderable lee way.

Sailing trim. Is expreffed of a fhip when in the beft ftate for failing.

Sally-port. A large port in the quarters of a fire-fhip where the captain comes out at, when he fets her on fire.

Salvage. A part of the value of a fhip and cargo paid to the falvors.

Scanting. The variation of the wind, by which it becomes unfavourable to a fhip's making great progrefs, as it deviates from being large, and obliges the veffel to fteer clofe-hauled, or nearly fo.

Scraper. A fteel inftrument to fcrape with.

Scudd. To go right before the wind; and going in this direction without any fail fet is called fpooning.

Scuttle. A fmall cover to cover a fmall hole in the deck.

Scuttling. Cutting large holes through the bottom or fides of a fhip, either to fink or to unlade her expeditioufly when ftranded.

Sea. A large wave is fo called. Thus they fay, A HEAVY SEA. It implies likewife the agitation of the ocean, as A GREAT SEA. It expreffes the direction of the waves, as A HEAD SEA. A LONG SEA means an uniform and fteady motion of long and extenfive waves; a SHORT SEA, on the contrary, is when they run irregularly, broken, and interrupted.

Sea-boat. A veffel that bears the fea firmly, without ftraining her mafts, &c.

Sea-clothes, Jackets, trowfers, &c.

Sea-mark. A point or object on fhore, confpicuoufly feen at fea.

Seams. The joints between the planks.

Sea-room. A fufficient diftance from the coaft or any dangerous rocks,

rocks, &c. so that a ship may perform all nautical operations without danger of shipwreck.

Seaze. To bind or make fast.

Seazeing The spun-yarn, marline, &c. to seize with.

Sending. The act of pitching precipitately into the hollow between two waves.

Serve. To wind something about a rope to prevent it from chafing or fretting. The service is the thing so wound about the rope.

Setting. The act of observing the situation of any distant object by the compass.

To set sail. To unfurl and expand the sails to the wind, in order to give motion to the ship.

To set up. To increase the tension of the shrouds, back-stays, &c. by tackles, laniards, &c.

Settle. To lower; as, SETTLE THE TOP-SAIL HALYARDS, lower them.

Shank of an anchor. The part between the ring and the flewks.

Shank-painter. The rope by which the shank of the anchor is held up to the ship's side; is also made fast to a piece of iron chain, in which the shank of the anchor lodges.

To shape a course. To direct or appoint the track of a ship, in order to prosecute a voyage.

Sheer. The sheer of the ship is the curve that is between the head and the stern, upon her side. The ship sheers about, that is, she goes in and out.

Sheers, are spars lashed together, and raised up, for the purpose of getting out or in a mast.

Sheering. The vessel is said to sheer when the cable and anchor is not right a-head.

Sheer-hulk. A vessel to take out and put in the lower masts and bowsprit.

To sheer off. To remove to a greater distance.

Sheet. Ropes fixed to the lower corners of square sails, &c.

To sheet home. To haul the sheets of a sail home to the block on the yard-arm.

To shift the helm. To alter its position from right to left, or from left to right.

To ship. To take any person, goods, or thing, on board. It also implies to fix any thing in its proper place; as, to SHIP THE OARS, to fix them in their rowlocks.

Ship-shank. A double bight taken in a rope with a hitch at each end.

Ship shape Doing any thing in a sailor-like manner.

Shivering. The state of a sail when fluttering in the wind.

Shoal. Shallow, not deep.

Shoe. A piece of wood in the shape of a shoe, used in fishing the anchor, to prevent the bill from rubbing the planks, or catching the bends.

To shoot a-head. To advance forward.

Shore. A general name for the sea-coast of any country.

To shorten sail. Used in opposition to MAKE SAIL.

Shrouds. Large ropes fixed on each side of masts.

Sinnett. A small platted rope, made from rope-yarns.

Skidds. Pieces of wood to put over the side, to hinder any thing from rubbing the sides.

Slack

Slack-water. The interval between the flux and reflux of the tide, when no motion is perceptible in the water.

To ſlip the cable. To let it run quite out when there is not time to weigh the anchor.

To ſlue. To turn any cylindrical piece of timber about its axis without removing it. Thus, TO SLUE A MAST or BOOM, is to turn it in its cap or boom-iron.

Sound. To try the depth of water; alſo a deep bay.

Spars. Pieces of trees as they are cut in the wood.

Spaniſh-burton-windlaſs. A particular way of ſetting up the topmaſt rigging in merchant veſſels.

Spear of the pump. The handle of an hand-pump.

To ſpill the mizen. To let go the ſheet, and brail it up.

To ſpill. To diſcharge the wind out of the cavity or belly of a ſail, when it is drawn up in the brails, in order to furl or reef it.

Spilling-lines. Are ropes contrived to keep the ſails from being blown away, when they are clewed up, in blowing weather.

Splice. To make two ends of ropes faſt together by untwiſting them, and then putting the ſtrands of one piece with the ſtrands of the other.

Split. The ſtate of a ſail rent by the violence of the wind.

Spoon-drift. The diſtance ſhe runs when ſcudding without any ſail.

Spray. The ſprinkling of a ſea, driven occaſionally from the top of a wave.

Spring. A ſpring upon the cable, is a hawſer bent to the cable, outſide the hawſe, taken in at the moſt convenient part of the ſhip aft, for the purpoſe of caſting her.

Spring-ſtays. Are rather ſmaller than the ſtays, placed above them, and intended to anſwer the purpoſe of the ſtay, if it ſhould be ſhot away, &c.

Spring-tides. Are the tides at new and full moon, which flow higheſt and ebb loweſt.

To ſpring a maſt, yard, &c. To crack a maſt, yard, &c. by means of ſtraining in blowing weather, ſo that it is rendered unfit for uſe.

To ſpring a leak. When a leak firſt commences, a ſhip is ſaid to SPRING A LEAK.

To ſpring the luff. A ſhip is ſaid to SPRING HER LUFF when ſhe yields to the effort of the helm, by ſailing nearer to the wind than before.

Spun-yarn. Two, three, or four rope-yarn twiſted together.

Spur-ſhores. Are large pieces of timber which come abaft the pump-well.

Spurling-line. Is a line that goes round a ſmall barrel, abaft the barrel of the wheel, and coming to the front beam of the poop-deck, moves the tell-tale with the turning of the wheel, and keeps it always in ſuch poſition as to ſhew the poſition of the tiller,

Squadron Five ſail of the line.

Squall. A ſudden violent blaſt of wind.

Square. This term is applied to yards that are very long, as TAUNT is to high maſts.

To ſquare the yards. To brace the yards, ſo as to hang at right angles with the keel.

To

To ſtand on. To continue advancing.

To ſtand in: To advance towards the ſhore.

To ſtand off. To recede from the ſhore.

Starboard. The right-hand ſide of the ſhip, when looking forward.

Starboard-tack. A ſhip is ſaid to be on the STARBOARD-TACK when ſailing with the wind blowing upon her ſtarboard ſide.

Starboard the helm! An order to puſh the helm to the ſtarboard ſide.

To ſtay a ſhip. To arrange the ſails, and move the rudder ſo as to bring the ſhip's head to the direction of the wind, in order to get her on the other tack.

Stay-peak. When the cable makes the ſame angle as the ſtay doth.

Stays. Large ropes coming from the maſt heads down before the maſts, to prevent them from ſpringing, when the ſhip is ſending deep.

Steady! The order to the helmſman to keep the ſhip in the direction ſhe is going at that inſtant.

Steady. In ſailing, is when ſhe is going her right courſe off the wind.

Steady the ſhip. That is by running a rope or towling out on either ſide when at anchor.

Steering. The art of directing the ſhip's way by the movement of the helm.

Steerage-way. Such degree of progreſſive motion of a ſhip as will give effect to the motion of the helm.

Steeve. Turning up. The bowſprit ſteeves too much, that is, it is too upright.

To ſtem the tide. When a ſhip is ſailing againſt the tide at ſuch a rate as enables her to overcome its power, ſhe is ſaid to STEM THE TIDE.

Stem. The fore part of the veſſel.

Stern. The after part of the veſſel.

Sternfaſt. A rope confining a ſhip by her ſtern to any other ſhip or wharf.

Sternmoſt. The fartheſt a-ſtern, oppoſed to HEADMOST.

Stern-way. The motion by which a ſhip falls back with her ſtern foremoſt.

Stiff. The condition of a ſhip when ſhe will carry a great quantity of ſail without hazard of overſetting. It is uſed in oppoſition to CRANK.

Stirrup. A piece of rope; one end nailed to the yard, in the other a thimble for the horſe to reave in.

Stoppers. Large kind of ropes, which being faſtened to the cable in a ffcrent places abaft the bitts, are an additional ſecurity to the ſhip at nchor.

To ſtow. To arrange and diſpoſe a ſhip's cargo.

Strand. One third part of a three-ſtrand rope.

Stranded. When a veſſel is got aground on ſome rocks, and filled with water.

To ſtream the buoy. To let it fall from the ſhip's ſide into the water, previouſly to caſting anchor.

Stretch-out. A term uſed to the men in a boat, when they ſhould pull ſtrong.

To

To strike. To lower or let down any thing. Used emphatically to denote the lowering of colours in token of surrender to a victorious enemy.

To strike soundings. To touch ground with the lead, when endeavouring to find the depth of water.

Strops. Either rope or iron, which are fixed to blocks or dead eyes to attach them to any thing.

Sued or *Sewed.* When a ship is on shore, and the water leaves her, she is said to be sued; if the water leaves her two feet, she sues, or is sued two feet.

Surf. The swell of the sea that breaks upon the shore, or on any rock.

To surge the capstern. To slacken the rope heaved round upon it.

Sway. The same as Hoist.

Sway away. Hoist, used in getting up masts or yards.

Swabb. A kind of large mop made of junk to clean a ship's deck with.

Swell. The fluctuating motion of the sea either during or after a storm.

Sweeping. The act of dragging the bight or loose part of a rope along the surface of the ground, in a harbour or road, in order to drag up something lost.

Swift the capstern bars. Is to confine the outward end of the bars one to another, with a rope.

Swinging. The act of a ship's turning round her anchor at the change of wind or tide.

To tack. To turn a ship about from one tack to another, by bringing her head to the wind.

Taking-in. The act of furling the sails. Used in opposition to SETTING.

Taken a-back. See A-back.

Tarpaulin. A cloth of canvas covered with tar and saw-dust, or some other composition, so as to make it water proof.

Taught. Improperly, though very generally, used for TIGHT.

Taunt. High or tall. Particularly applied to masts of extraordinary length.

Tell-tale. An instrument which traverses upon an index in the front of the poop deck, to shew the position of the tiller.

Tending. The turning, or swinging, of a ship round her anchor in a tide-way at the beginning of ebb and flood.

Thwart. See A-THWART.

Thwart ships. See A-THWART SHIPS.

Thus! An order to the helmsman to keep the ship in her present situation, when sailing with a scant wind.

Tide-way. That part of a river in which the tide ebbs and flows strongly.

Tier. A row; as cable-tier, a tier of guns, casks, or a tier of ships, &c.

Tide-gate. A place where the tide runs strong.

Tide it up. To go with the tide against the wind.

Timbers. What the frame is composed of.

Tiller. A large piece of wood, or beam, put into the head of the rudder, and by means of which the rudder is moved.

Tompions, or *Tomkins.* The bung, or piece of wood, by which the mouth of the cannon is filled to keep out wet.

Topping. Pulling one of the ends of a yard higher than the other.

To tow. To draw a ship in the water by a rope fixed to a boat or other ship which is rowing or sailing on.

Tow-line. A small line cable laid.

Transom. A large piece of timber fastened to the stern-posts, to the ends of which the afterpart of the bends are fastened.

Traverse. To go backwards and forwards.

Traveller. A ring on the jib boom, or grumet on the backstays, to conduct the top-gallant yards up and down.

Trey-sail. A small sail used by brigs and cutters in blowing weather.

Trice, trice up. To haul up and fasten.

Trim. The state or disposition by which a ship is best calculated for the purposes of navigation.

To trim the hold. To arrange the cargo regularly.

To trim the sails. To dispose the sails in the best arrangement for the course which a ship is steering

To trip the anchor. To loosen the anchor from the ground, either by design or accident.

Trough of the sea. The hollow between two waves.

Truck of a gun carriage. Is the wheel upon which it runs.

Truck. A round piece of wood put on the top of flag-staffs, with sheaves on each side for the halyards of the flags to reeve in.

Trunions of a gun. Are the arms, or pieces of iron, by which it hangs on the carriage.

Trunnels. Pieces of timber to fasten the plank to the timbers.

Trying. The situation in which a ship, in a tempest, lies-to in the trough or hollow of the sea, particularly when the wind blows contrary to her course.

Turning to windward. That operation in sailing whereby a ship endeavours to advance against the wind.

Van. The foremost division of a fleet in one line. It is likewise applied to the foremost ship of a division.

Vane. A small kind of flag worn at each mast head.

To veer. To change a ship's course from one tack to the other, by turning her stern to windward.

Veer. Let out; as veer away the cable.

Veer. Shift. The wind veers, that is, it shifts or changes.

Viol, or *Voyal* A block through which the messenger passes in weighing the anchor. A large messenger is called a viol.

To unballast. To discharge the ballast out of a ship.

To unbend. To take the sails off from their yards and stays. To cast loose the anchor from the cable. To untie two ropes

To unbit. To remove the turns of the cable from off the bits.

Under-foot. Is expressed of an anchor that is directly under the ship.

Under-sail. When a ship is loosened from moorings, and is under the government of her sails and rudder.

Under-way. The same as UNDER-SAIL.

Under the lee of the shore. Is to be close under the shore which lies to windward of the ship.

Unfurl. Cast loose the gasket of the sails.

To unmoor. To reduce a ship to the state of riding at single anchor, after she has been moored.

To unreeve. To draw a rope from out of a block, thimble, &c.

To

To unrig. To deprive the ſhip of her rigging.

Uvrou. The piece of wood by which the legs of the crow-foot are extended.

Wake. The path or track impreſſed on the water by the ſhip's paſſing through it, leaving a ſmoothneſs in the ſea behind it. A ſhip is ſaid to come into the wake of another when ſhe follows her in the ſame track, and is chiefly done in bringing ſhips to, or in forming the line of battle.

Wales. Are ſtrong timbers that go round a ſhip a little above her water line.

Ware. See To VEER.

Warp. To warp a ſhip, is to draw her againſt the wind, &c. by means of anchors and hawſers carried out.

Warp. A hawſer, or ſmall cable.

Water-line. The line made by the water's edge when a ſhip has her full proportion of ſtores, &c. on board.

Water-borne. The ſtate of a ſhip when there is barely a ſufficient depth of water to float her off from the ground.

Water-logged. The ſtate of a ſhip become heavy and inactive on the ſea, from the great quantity of water leaked into her.

Water-tight. The ſtate of a ſhip when not leaky.

Weather. To weather any thing, is to go to windward of it.

Weather-beaten. Shattered by a ſtorm.

Weather-bit. A turn of the cable about the end of the windlaſs.

Weather-gage. When a ſhip or fleet is to windward of another, ſhe is ſaid to have the WEATHER GAGE of her.

Weather-quarter. That quarter of the ſhip which is on the windward ſide.

Weather-ſide. The ſide upon which the wind blows.

To weigh anchor. To heave up an anchor from the bottom.

Whipping. To bind twine round the ends of ropes, to hinder them from fagging out.

To wind a ſhip. To change her poſition, bringing her head where her ſtern was.

Wind-road. When a ſhip is at anchor, and the wind, being againſt the tide, is ſo ſtrong as to overcome its power, and keep the ſhip to leeward of her anchor, ſhe is ſaid to be WIND-ROAD.

Wind's-eye. The point from which the wind blows.

To windward. Towards that part of the horizon from which the wind blows.

Windward tide. A tide that ſets to windward.

To work a ſhip. To direct the movements of a ſhip, by adapting the ſails, and managing the rudder, according to the courſe the ſhip has to make.

To work to windward. To make a progreſs againſt the direction of the wind.

Would. To would, is to bind round with ropes; as, the maſt is woulded.

Weigh. To haul up; as, weigh the anchor.

Yawing. The motion of a ſhip when ſhe deviates from her courſe to the right or left.

Yards. The timbers upon which the ſails are ſpread.

Yarn. See ROPE YARN.

Explanation of the Plate describing the Rigging, &c. of a First Rate Man of War.

1 BOWSPRIT
2 Gammoning
3 Cap
4 Bobftay
5 Manrope
6 Spritfail yard
7 Lifts
8 Standing lifts
9 Horfes
10 Parrel
11 Braces and pendants
12 Sheets and pendants
13 Clewlines
14 Buntlines
15 Jib-boom
16 Traveller
17 Horfe
18 Stay
19 Halyards
20 Guy
21 Jack ftaff
22 Truck
23 Jack flag
Fore, main, and mizen-maft, rigged alike, as in the top-maft and top-gallant maft, and all the yards, except the crofs-jack yard, which has no fail; therefore the defcription of one ferves for the other, except where otherways expreffed.
24 Foremaft
25 Woulding
26 Fifh
27 Top
28 Cap
29 Runner and tackle
30 Shrouds
31 Lanyards
32 Ratlines
33 Stay and landyard
34 Spring ftay and ditto
35 Snakeline
36 Crowfoot
37 Fore yard
38 Geers
39 Lifts
40 Braces and pendants
41 Clewlines
42 Buntlines
43 Horfes and ftirrups
44 Leechlines
45 Yard tackles
46 Bowlines and bridles
47 Tacks
48 Sheets
49 Trufs parrel
50 Pudding
51 Dolphin
52 Toprope
53 Topmaft
54 Crofstrees
55 Cap
56 Runner
57 Shrouds and lanyards
58 Stays
59 Backftays
60 Stayfail halyards
61 Topfail yard
62 Tye and halyard
63 Lifts
64 Braces and pendants
65 Horfes
66 Parrel
67 Flemifh horfe
68 Buntlines
69 Clewlines
70 Bowlines and bridles
71 Reef tackles and pendants
72 Jewel blocks
73 Sheets
74 Top-gallant maft
75 Shrouds
76 Stay
77 Backftay
78 Top-gallant yard
79 Halyard
80 Lifts
81 Horfe
82 Parrel
83 Clewline
84 Bowline
85 Sheet
86 Royal maft
87 Stay
88 Backftay
89 Truck
90 Admiralty flag
91 Middle-ftay-fail ftay
92 Halyards
93 Top-gal.ftay-fail halyards
94 Mizen gaff
95 Derrick and fpan
96 Peek brails
97 Spanker halyards
98 Vangs
99 Crofs jack yard
100 Spanker boom
101 Topin lift
102 Poop lanthorn
103 Stern ladder
104 Rudder chains
105 Standard flag
106 Union flag
107 Enfign ftaff
108 Enfign flag
109 Futtock fhrouds
110 Cable

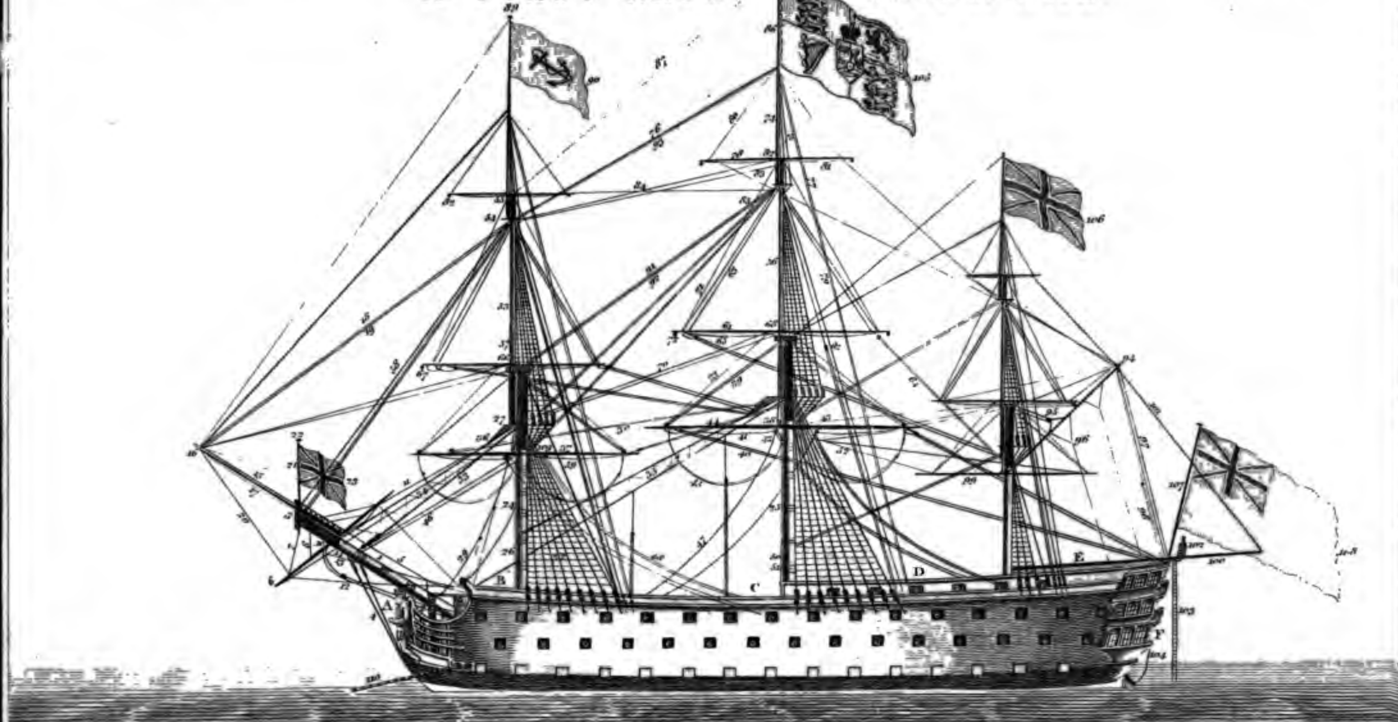
HULL.

A Head or ftem
B Forecaftle
C Waift
D Quarter-deck
E Poop
F Stern or abaft

The

Face Page

A FIRST RATE SHIP OF WAR.



J. Beaslow del.   R. Pranty sculp.

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The following Questions and Answers are recommended to the perusal of young Gentlemen belonging to the Sea, in order to refresh their Memories, previous to that Examination which they must pass through, before they are appointed to a Commission in the Royal Navy, or an Officer in the East India Service; as it is probable similar ones may be asked by those appointed to examine them, at the Navy Office and the East India House.

Quest. HOW do you find the golden number?

A. I add one to the given year, and divide the sum by 19, the remainder will be the golden number.

Q. How do you find the epact for any year?

A. By dividing the given year by 19, and multiplying the remainder by 11, the product will be the epact, if it does not exceed 30; but if it does, I subtract 30 from it as often as I can, and the remainder will be the epact.

Q. How do you find the moon's age?

A. To the epact I add the day of the month, and the number of the month; their sum will be the moon's age, if it does not exceed 30; but if it does, I subtract 30 from it as often as I can, and the remainder will be her age.

Q. How do you find the moon's southing, or the time of her coming to the meridian?

A. I multiply the moon's age by 48, and divide the product by 60; the quotient will be the hours, and the remainder the minutes when she is on the meridian past noon: Or, I may multiply the moon's age by 4, and divide the product by 5, the quotient will be the hours, and the remainder, multiplied by 12, will be the minutes when she souths, or is on the meridian, in the afternoon: But if this time should exceed 12, I subtract 12 from it, and the remainder will be the time of her southing in the morning.

Q. How do you find the time of high water at any place?

A. To the moon's southing on the given day, I add the time of high water, full and change, at the given place, and the sum will be the time of high water there in the afternoon; but if this time should exceed 12, I subtract 12 from it, and the remainder will be the time of high water in the morning; and if it exceeds 24, I subtract 24 from it, and the remainder will be the time of high water in the afternoon *.

Q. Suppose that you go into an harbour, and find by your watch that it is high water at any hour of the day; by what means do you find the times when it is high water on full and change days in that place?

A. I find the time of the moon's southing on that day, and subtract it from the time of high water at the given place, if I can, and that will be the time of high water. If I cannot, I add 12 to it, and then subtract the above time; the remainder will be the time of high water at the given place, on full and change days.

* The time of high water is found more correct by the Tables, see page 128, & 130.

Q. How

Q. How do you find the zenith distance of any object?

A. By correcting the altitude for the dip, refraction and semidiameter, and then subtracting it from 90°, the remainder will be the zenith distance, which will be either north or south, according as the object bears of me.

Q. Suppose the zenith distance 10° north, and the declination 20° north, what latitude are you in, and of what name?

A. Ten degrees north.

Q. The sun is in your zenith, what latitude are you in?

A. The same as the declination is, whether north or south.

Q. Your zenith distance is 20° north, and your declination is 20° north, what latitude are you in?

A. Upon the equator, and consequently in no latitude.

Q. Suppose that your zenith distance is 50° south, and the declination 10° north, what latitude are you in?

A. Sixty degrees north.

Q. Suppose your zenith distance be 45° north, and the declination 15° south, what latitude are you in?

A. Sixty degrees south.

Q. Suppose your zenith distance is 45° north, and the declination 15° north, what latitude are you in?

A. Thirty degrees south.

Q. What do you mean by the word amplitude?

A. The true amplitude is the number of degrees that the sun, moon, or stars, rise and set, to the northward or southward of the true east or west. The magnetic amplitude is the number of degrees they rise or set to the northward or southward of the east or west point of the compass.

Q. How do you find the true amplitude?

A. As the co-sine of the latitude: is to the radius : : so is the sine of the sun or star's declination: to the sine of the true amplitude. Or if the secant of the latitude be added to the sine of the sun or star's declination, the sum (rejecting 10 in the index) will be the log. sine of the true amplitude.

Q. But supposing the evening or morning proves cloudy, and you cannot see the sun or star, how will you find the variation of the compass?

A. By an azimuth.

Q. What do you mean by an azimuth?

A. The true azimuth is the distance of the sun or star from the true north or south at every degree and minute of altitude.

The magnetic azimuth is their distance, at each degree and minute of altitude from the north or south point of the compass.

Q. How do you find the true azimuth?

A. By adding the complement of the latitude, the complement of the altitude, and the sun or star's polar distance into one sum; from half this sum I subtract the polar distance, noting the half sum and the remainder: Then, to the arithmetical complement of the co-sine of the latitude, I add the arithmetical complement of the co-sine of the altitude; the log. sines of the half sum and the remainder; half the sum of these four logarithms will give the co-sine of half the true azimuth, which being doubled is the true azimuth, reckoned from the north in north latitude, and from the south in south latitude.

Or, it may be found thus:

To the log co-secants of the co-latitude and altitude, add the log. sines of the half sum and the remainder; half the sum of these four logarithms (rejecting 20 in the index) will be the log. co-sine of half the true azimuth, as before.

Q. You

Q. You have given the true amplitude or azimuth by calculation, and the magnetic amplitude or azimuth by obfervation; how do you find the variation?

A. By placing both the amplitudes or azimuth before me; then, if the true amplitude or azimuth be to the right hand of the magnetic, or obferved, the variation is eaft, but if it be to the left hand, it is weft.

Q. You have the latitude and longitude the fhip is in, confequently her place, how do you fhape her courfe, or in other words, find her courfe and diftance to any other place, whofe latitude and longitude is known?

A. It may be found briefly by the tables of difference of latitude and departure, bnt by logarithms I will fay,

As the meridional difference of latitude : is to radius :: fo is the difference of longitude : to the tangent of the courfe. And

A. As the co-fine of the courfe : is to the proper difference of latitude :: fo is radius : to the diftance.

Q. You have the difference of latitude and departure made good in the 24 hours, how do you find the courfe and diftance, and the fhip's place, by logarithms?

A. As the difference of latitude : is to radius :: fo is the departure : to the tangent of the courfe. And,

As the co-fine of the courfe : is to the difference of latitude :: fo is radius : to the diftance made good in the 24 hours.

Having the latitude and longitude left, and the difference of latitude, I find the latitude in, and the meridional difference of latitude; I then fay,

As the co-fine of the courfe : is to the meridional difference of latitude, :: fo is the fine of the courfe : to the difference of longitude. Or, as the proper difference of latitude : is to the departure :: fo is the meridional difference of latitude : to the difference of longitude. Having the longitude left, and the difference, the longitude in is found by addition or fubtraction, as the cafe requires.

Q. You have now the fhip's place by calculation, how do you find it on a Mercator's Chart?

A. By laying a ruler acrofs the Chart on the fhip's latitude, and taking her longitude in my compaffes, and fetting one point on the meridian, by the fide of the ruler, I turn the other eaft or weft, according as the longitude is, (by the fide of the ruler) and it will point out the fhip's place.

Q. You have now the fhip's place, how do you find her bearing and diftance to any other known place?

A. By laying a ruler over the point where the fhip is, and the given place, and with the compaffes I take the neareft diftance between the ruler and the centre of fome compafs on the Chart; and flide the compaffes along the ruler (keeping both points perpendicular to it) the fartheft point from the ruler will fhew the courfe, or bearing, between the fhip and place. Again,

I take the diftance between the fhip and place in the compaffes, and then lay one point on the meridian as much below the fhip's place, as the other is above the given place; that diftance, reckoned in degrees, leagues or miles on the meridian, according as it is divided, will be the diftance.

Q. You are ordered to a fhip, fhe is lying in dock; prepare to take her out of dock.

A. I

A. I would take on board what kentledge was necessary, stream anchor and cable, kedge-anchor, hawser and towline, with some spare ropes for guys, to keep her fair for the dock gates; buoy and buoy ropes, for stream and kedge.

Q. When your ship is out of dock, what is first to be done?

A. I would secure her, then take on board the remainder of the kentledge and level the hold; by laying the kentledge from the fore part of the fore hatchway to the after-part of the after hatchway.

Q. If you are taking in bales, how would you dunnage, and which part of the ship most?

A. I would dunnage six inches, and mostly about the pump well, main hatchway, the wake of the chains and floor timber heads.

Q. Suppose you have one and a half foot water in your hold, and your ship heels four streaks; what dunnage ought you to have to preserve the cargo?

A. Three feet.

Q. How would you moor your ship at Gravesend?

A. I would come to with my small bower, veer the service into the hawse, and then hang my best bower anchor to the long boat, and with the tide drop her a stern: when the cable is taut, let go the anchor, first letting go the shank rope, to keep the cable more taut.

Q. How would you hang the anchor to the long boat?

A. Take the buoy-rope over the roller (which is in the middle of the stern of the long boat), bring the bight round the main thwart, cockbill the anchor, hook the cat to the anchor, and lower away, until the flukes of the anchor are clear of the boat's bottom, then make fast the buoy-rope, have a shank-rope through the ring, (which is at the boat's stern-post) pass it round the shank of the anchor, make it fast to the after thwart, lower away and unhook the cat, then veer away the cable; be careful to heave the buoy over board and spare buoy rope before you let go the anchor.

Q. How do you moor in the Downs?

A. With my best bower to the S W. I would veer away with the last quarter stream tide, and moor with the small bower to the N. E.

Q. Where is the best anchoring in the Downs?

A. Upper Deal church and castle in one, in eight or nine fathoms water.

Q. What are the marks for anchoring in the Downs?

A. The South Foreland S. S. W. Deal castle bearing West, and Sandown castle N. W.

Q. How would you unmoor in the Downs with the wind at North?

A. I would splice my stream cable to my small bower, and veer away at

NOTE. All cables ought to be 120 fathoms in length, and are in proportion to each other as the cubes of their diameters. The number of threads of which a cable is composed being always proportioned to the length and thickness, and the weight and value of it is determined by this number. The number of threads and weight of cables of different circumferences may be seen in the following Table:

Circumference in Inches.	Threads or Rope Yarns.	Weight in Pounds.	Circumference in Inches.	Threads or Rope Yarns.	Weight in Pounds.
9	393	1572	15	1095	4372
10	485	1940	16	1244	4976
11	598	2394	17	1404	5616
12	699	2796	18	1574	6295
13	821	3284	19	1754	7016
14	952	3808	20	1945	7772

at half ebb, that I might have time to ftow my beft bower, and fhorten in my fmall bower cable, before the fhip tends to windward.

Q. Proceed to unmoor fhip as it is done in the navy.

A. I would fend for the mafter to fee the hawfe is clear, turn all hands up to unmoor fhip, lay the capftan bars for fhipping, call the mate to fee the meffenger paffed for the beft bower, rig the davit out, becaufe I will take it up the firft quarter flood, get the cat and fifh to pafs for the beft bower, ftretch along the fifh-tackle; quarter-mafters down in the tier, and ftand by to veer away the fmall bower cable; fhip the capftan bars, pin and fwift them; clap on the ftoppers before the bitts, and bring to the meffenger. At the fame time unbit the beft bower, rowfe aft the flack cable; heave taut, take off the ftoppers, hold on the meffenger, and heave away; veer away the fmall bower cable; clap on the nippers. Thick and dry for weighing, heave cheafly; the anchor's away, keep faft the fmall bower cable; quarter mafter take hold of the helm; look out for the anchor; the anchor is in fight; heave and paul the capftan; hook the cat; haul taut, and take a turn; furge the meffenger round the capftan; take off the nippers; out cable; cable enough; haul cat; belay the catfall; pafs the ftopper; hook the fifh; try fifh by hand; haul with the fifh; belay the fifh-tackle fall; pafs the fhank painter; bowfe too the ftock with the tackle; belay the fhank-painter; make faft the ftopper and ftock lafhing; come up cat and fifh; unhook both; haul the buoy and buoy rope in; then fhift the meffenger for the fmall bower and bring too, clap on the ftoppers before the bitts and unbit the cable; rowfe aft the flack cable; man the capftan; hold on the meffenger; forecaftle-men rig out the davit for the fmall bower; when the anchor is a ftay peek, fend the top men to loofe the fails; man the yards; ftretch along the topfail fheets; let fall the topfails; overhaul reef tackles, bunt-lines and clue-lines; foot the fails out of the top; haul home the topfail-fheet; ftretch along the topfail-halyards and man them; quarter-mafter and boatfwain's mates attend to the braces; hoift away the topfails; topfails atrip; belay the halyards; trim the fails; heave up the anchor; ftow it as before, and haul the buoy and buoy rope in.

Q. How would you unmoor with the wind S. E. or S.?

A. Veer on the beft bower cable, and take the fmall bower-anchor up firft; and proceed as before, then heave in to the fhort fervice on the beft bower, &c. If the anchor has great hold and afraid of ftanding the meffenger, clear away the main capftan and lafh a block, or purchafe blocks, on the cable, and one to the main-maft, or one to the two ports abreaft of the main-maft; reeve a hawfer through them, and heave on both capftans together.

Q. Suppofe you are clofe upon a wind, in moderate weather, with all your fails fet, how will you tack the fhip?

A. I would ftretch along the lee bow-lines, and weather-braces, the weather-fheets and lee-tacks; then put the helm a-lee, let go the fore fheet, lee fore-top fail, brace and fore-top bow-line; jib and ftay-fail fheets. When the fore top fail touches, brace too and help her; when aback, brace up and help her; when the wind is out of the after fails, raife tacks and fheets; fhift the ftay-fail tacks, and haul over the ftay-fail fheets; when the wind is rather ½ a point on the bow, if fure of coming about, haul the main fail. *N.B.* One watch of the top-men on the quarter-deck, and fore-caftle to fet up the weather-breaft back-

 ftays.

ftays. If fhe has ftern way. fhift the helm and top the fprit-fail yard; haul on board the main tack and aft the main fheet. Brace up the main yard when the after fails are full; haul off all; and haul on board the fore tack; keep in the weather braces forward, and let her come to, then brace up; haul aft the fore-fheet, jib and ftay-fail fheets; (fet up the back-ftays when the fhip is head to wind) and haul the bow-lines; then haul taut the weather-braces, lee tacks, and weather-fheets; have the braces let go at once; when the word is given to haul mainfail, (all the hands on the braces fhould keep hauling taut in for the run) the yards will fwing of themfelves.

Q. How would you tack a fhip under her three top-fails?

A. I would put the helm a-lee, eafe off the fore-top fail brace, keep faft the fore top bowline: when the fore top-fail touches, brace to and help her; when the wind is a-head, haul the main top-fail and fhift the helm: then brace up the main yard, and haul the main-top bowline; when the after-fails are full, let go and haul; keep in the weather-braces forward, and when fhe comes to brace fharp up, haul the main and fore-top bowlines, haul taut the weather braces, and top the fprit-fail yard.

Q. How do you veer, or wear a fhip with all her fails fet?

A. I would haul the mizen up, and the mizen ftay-fail down, or brail it up, hard a weather the helm, fhiver the mizen top-fail, let go the main and main-top bowlines, eafe off the main fheet, the lee main brace, and round in the weather brace. When the wind is abaft the beam, raife the main tack; when the wind is aft, fquare the head yards, and get the other tacks on board; haul aft the fheets, fhift the jib and ftay-fail fheets over the ftays, and as fhe comes to, haul the mizen out; hoift the mizen ftay-fail, and haul aft the fheet; brace the head yards up, haul the bowlines, and trim all fharp. If a frefh wind, and fhould be proper to fhorten fail, in top gallant fails, down jib and ftay-fails, take one or two reefs in the top fails.

Q. It blows hard, how would you proceed to clofe reef the top-fails?

A. I would let run the halyards, and haul the yards clofe down by the clew-lines and down-haul tackles; if the wind is large, man the clew-lines and bunt-lines, let go the fheets, and clew them clofe up; haul in the weather-brace, and fpill the fail as much as poffible; then haul out the reef tackles, fend men up and haul up the weather earing firft, then the lee one and reef away, hauling the other reefs up before the yard: If the fhip is upon a wind when the top-fail yard is down, let go the bowline. It is moftly the way to man the clew-lines and the bunt-lines, eafe off the lee fheet and clew it up: hauling in the weather brace at the fame time; when the fail is fpilled, haul out the reef-tackles, and reef as before. But to keep the fail from fplitting or fhaking (efpecially if it be wet) it is the beft way to man the clue-lines, bunt-lines, and weather-brace, let go the lee-brace, eafe off the weather fheet, hauling up the clue-line, and in with the weather-brace at the fame time; when in enough, eafe off the lee-fheet, clew up, &c. N.B. To fet a top-fail on a wind when it blows ftrong, always haul the lee-fheet home firft, then the weather one, &c. as before.

Q. It blows harder, you muft take in your topfails?

A. I would take in the fore and mizen top-fails firft, becaufe it will eafe the fhip forward (for when it blows hard we generally have a head fea, and fhe keeps to the better) let go the fore-top bowline, lower away the halyards, man the clue-lines and bunt lines, clue clofe up, and haul

out the reef-tackles, haul in the weather-brace, ſteady the lee-brace, haul taut the top ſail halyards; ſend the people up to hand the ſail, and when up, before they go on the yard, I'll clap the rolling tackle on to ſteady it, and a piece of canvaſs abreaſt of the lee top-maſt ſhrouds after the ſail is handed; (all the top ſails ſhould be taken in the ſame way) after that, if ſqually, take in the main top-ſail, and then the ſhip is under her courſes.

Q. How would you veer a ſhip under her courſes?

A. I would haul the mizen and main-ſail up, and down mizen ſtay-ſail, ſquare the after yards, hard a weather the helm, man the weather fore-brace, and eaſe off the lee-brace and fore bowline; eaſe off the fore-tack, and haul on board the other: keep her large, if room, until I get the tack on board and belay it: then luff up to the wind, haul aft the fore-ſheet and brace up the fore-yard, ſet the after-ſails, aboard main-tack, aft the main ſheet, brace all up, and haul the bowlines; when my ſails are trimmed, ſhift the rolling tackles on the top ſail yards.

Q. Suppoſe you are lying to in a hard gale of wind, under a reef main-ſail, you want the ſhip's head on the other tack; how will you veer in a great ſea?

A. I will watch her falling off, and put the helm a weather, when ſhe does, eaſe off the main ſheet; if that will not do, I'll man the fore-ſhrouds, and get tarpaulins and hammocks or ſpare canvaſs up, and ſpread it: If that will not do, I will haul aft the main ſheet, and put the helm a-lee, then ſend hands out to the ſprit-ſail yard with hammocks and gaſkets to ſtop the ſprit-ſail (called balancing) within the lee clew-line; block and looſe the lee yard-arm, then haul aft the ſheet, clap the helm hard a-weather, eaſe off the main ſheet, round in the weather-brace, gather aft the other ſheet, haul the main tack on board; when ſhe is before the wind, ſquare the ſprit-ſail yard, clue the ſail up and furl it; eaſe the helm down a-lee, brace the yards up, haul the main ſheet aft, bowſe the bowline up, laſh the helm three parts a lee, and ſhe will lay too as before.

Q. Suppoſe ſhe will not veer after all you have done?

A. I will looſe the gooſe wings of the fore-ſail; if that will not do, ſet the fore-ſail and veer her under her courſes, or haul the main-ſail up; if by hauling the main-ſail up and furling it ſhe does not veer, lower down the mizen-yard; if that will not do, lower down the croſs-jack yard and mizen top-maſt; if that will not do, cut away the mizen-maſt.

Q. How do you caſt a ſhip, when intending to get under weigh?

A. If I am to caſt her to ſtarboard, I would haul in my larboard braces forward, and let my after yards lay ſquare; I may hoiſt the fore top maſt ſtay-ſail, and keep the ſheet to windward to help her; If I am to caſt her to port, I would haul in the contrary braces, when caſt, fill the head ſails and brace up as circumſtances require. *N.B.* If a ſhip is wind-rode, as ſoon as the anchor is right up and down, put the helm the way you would have her caſt, ſetting in the ſame braces abaft, and the contrary forward: but if ſhe is tide-rode, the helm muſt be put the contrary way to which you would have her caſt, and ſet in the braces forward; which ever way the helm is, the braces abaft muſt be the contrary.

Q. It blows hard, and you ſplit your top-ſail?

A. I would let go the bowline, haul in the weather-brace, and lower

away the halyards, clew up the lee-ſheet, haul up the bunt-lines, ſtart the weather-ſheet, belay the clue-lines and bunt-lines, unbend the ſail, bend another; then either furl or ſet it, as circumſtances require.

Q. You are lying to in a hard gale of wind, and ſplit your main-ſail?

A. I will haul it up carefully, unbend the ſail, and bend another, get on board the main tack, and haul aft the ſheet; when the ſail is ſet, get a tackle on the weather-leach to ſecure the tack, and a preventer ſheet; but in ſmall ſhips they get the lee tack aft for a preventer ſheet.

Q. Suppoſe you are on a wind, and let the ſhip come up in the wind, and are all aback, what will you do?

A. I will box her off, and ſuppoſe ſhe will not box off, I will haul the mizen up, let go the main and main-top bow-lines, the lee main and main-top-ſail braces, and lay all ſquare abaft, put the helm to leeward, if ſhe has ſtern-way, when the wind is abaft the beam ſhift the helm; and, as ſhe gets head-way, haul in a little of the after-braces, haul the mizen out, brace up ſharp abaft and haul the bow-lines; and then I am on the ſame tack as before.

Q. Suppoſe you are on a wind, cloſe upon the land, and ſtanding on muſt run on ſhore, and you can clear the land on the other tack; but it blows hard and a head ſwell, that ſhe will not ſtay; and ſhould you veer you would be on ſhore, how would you get upon the other tack?

A. I would club-haul her; this is done by putting the helm a-lee, and letting go the lee-anchor, and bringing her head up to wind; then cut the cable and haul about the after-ſails; and when they are full brace about the head-ſails, haul on board the fore-tack, and brace up the other way.

Q. If by accident your ſhip is brought by the lee, what would you do?

A. When a ſhip is brought by the lee, it is commonly occaſioned by a large ſea, and by the neglect of the helm's-man. When the wind is two or three points on the quarter, the ſhip taking a lurch brings the wind on the other ſide, and lays the ſails all dead to the maſt; as the yards are braced up, ſhe then having little way, and the helm being of little ſervice. I would therefore brace about the head-ſails the other way, and keep the main-top-ſail ſhivering; when ſhe gathers way, and brings the wind aft again, raiſe the fore-tack and ſquare the head-ſails; trim the ſails as they were before, and bring her to her courſe again. *N. B.* It is dangerous to bring a ſhip by the lee in a gale of wind, for ſhe lying entirely againſt the ſea, her ſails can be of little ſervice till they are braced about.

Q. Coming into ſoundings from a long voyage, I would have you prepare for going into port and anchoring.

A. I'll order the cables to be bent; thus get their ends up, reeve, hauſe, and ring ropes to haul them out, the forecaſtle men to clinch them, and quarter-maſter to clap the bends on, reeve the runners and tackles, unſtow the anchors, bend the buoys and bouy-ropes, ſingle the ſtoppers and ſhank painters, bit the bower-cables with a long range, have the dog ſtoppers to paſs, ſee the tiers clear, have hand leads and lines in the chains, ſend down the top-ropes, reeve the top-tackle-falls, unſling the lower yards, when the cables are bent, &c. clap the hawſe bucklers on.

Q. You are off the Eddyſtone, the wind at S. W. in a hard gale, under a reef fore-ſail, and you muſt anchor in Plymouth Sound, how will you bring up for the ſafety of the ſhip, and with what anchor?

A. To give myſelf time for anchoring, I will haul my foreſail up, get the ſheet anchor over the ſide, and bit the cable to the after-bits with a range, get down top-gallant maſt, and ſprit-ſail yard, in fore and aft, unfid the top-maſts and ſtretch along the jeers, clap the wing ſtopper on the

ſecond

ſecond cable of the beſt bower; being all clear, I'll ſet my foreſail and ſteer in for the Sound, and when I am near the place I intend to anchor in, I'll man the fore clue garnets, and ſtand by to lower the yards and top-maſts, being ready, lower away, haul the fore-ſail cloſe up, and furl it a Portland, clap rolling tackles on the lower yards, and heel ropes on the top-maſts; having the marks on to anchor, ſtream the beſt bower buoy, and ſee that it goes clear of the ſhip, and when I intend to bring-up, put the helm down, and haul the mizen out, then let go the anchor and veer away at leaſt one and a half cable before I check her; ſhould the ſhip drive with two cables out, on the beſt bower, ſtream the ſmall bower-buoy and let go the anchor, which will allow me to veer a cable on the ſmall bower; this will bring her up if it blows ever ſo hard, and I have ſtill the ſheet anchor to ſtand by; when I have brought up, and double-bitted and ſtopered the cables, I'll get the top-ſail yards fore and aft in the tops, and make the ſhip as ſnug as poſſible; as ſoon as the gale is over, get the anchors up and moor properly. The beſt method is to unbend the ſmall bower buoy rope from the anchor, it being liable to get foul of the beſt bower cable, by the buoy going over and over again of the ſaid cable, which has been often the caſe. *N. B.* In coming from the weſtward with a hard gale of wind, and bound into the Downs, take the ſame method.

Q. Suppoſe you are on a lee ſhore, and had neither room to veer or ſtay, nor any anchoring ground, how would you put the ſhip's head round the other way.

A. I would put my helm hard a-lee; when ſhe comes head to wind, raiſe the fore and main tacks directly, make a run with my weather braces and lay all aback at once, then haul forward my lee-tacks and bow-lines as far as I can, that the ſhip may fall round on her heel, and when the main-ſail begins to ſhiver, I would haul it up, fill my head ſails, and ſhift the helm hard a-weather; when the wind comes on the other quarter, haul on board the main tack, and bring her cloſe to the wind.

Q. Suppoſe it blows hard, you cannot carry your courſes, night coming on, and it is likely to blow harder, what will you do?

A. I will haul the fore-ſail up and furl it, balance the mizen, haul it out to keep her to, then haul up the weather main clue-garnet and bunt-line, then the lee-clue-garnet-bunt-lines and leach-lines, ſquare the yards, and get ſtrops round the maſt above the booms to hook the yard tackles to for rolling tackles, then reef the ſail; when reefed, haul on board the tack, get aft the ſheet handſomely, tend the braces, bowſe up the bow-line, and haul up the mizen.

Q. You are juſt abreaſt of Portland, coming up Channel, the wind has taken you back; you have all ſails ſet, and you have no time to take them in, for you will be on ſhore or in the Race preſently, how will you proceed?

A. If ſhe has head-way, I will put the helm-a-port, let go the fore ſheet and larboard braces; as ſoon as the after-ſails ſhiver, haul down all the ſtud-ding-ſails; if it blows freſh take in top-gallant ſails, brace up the after-yards; when full, brace up forward and haul on board the fore-tack, trim all ſharp, and haul the bow-lines, and then haul taut the weather-braces.

Q. Suppoſe you are turning over the Flats with your top-ſails and fore-ſail, you endeavour to put about, but ſhe will not ſtay, there is a ſand a-head, within a cable's length of you, what will you do?

A. I will heave all aback, when ſhe has paid well off, ſhift the helm; brace about the head-ſails and ſhiver the after-ſails; then ſhe will veer round and ſtand off.

Q. You

Q. You are in a gale of wind, and split your fore-course, what will you do?

A. I'll man the weather fore clue-garnet, bunt-lines and leach-lines, ease off the fore-tack, and when clued up, man the lee-clue-garnet and haul it close up; let go the lee-brace; when I let go the sheet and square the yard, haul taut the lifts and braces, send hands to unbend the sail; when another is bent, and I want to set it, I will haul on board the fore-tack, and haul aft the fore-sheet, brace the yard up and haul the bow-line.

Q. It blows hard, and you want to reef your courses, how would you proceed?

A. I will let go the top-sail sheets and lifts, man the down-haul tackles, lower away the jeers, let go the bow-lines and clue the sails up, round in the weather-braces, haul taut the lifts, braces, and rolling tackles; then send hands up to reef the sails; when I want to set them, I will proceed with the sails as before.

Q. Suppose it blows hard at S. W. and you are drove from your anchors in the Downs, what would you do?

A. I would steer for the Gull-stream, which I shall know by having the upper Light on the South Foreland to bear S. W. by S. then steer away between the N. E. and N. E. by N. which will carry me between the Brake and the Goodwin Sands, keeping to the Goodwin in nine or ten fathom, and to the Brake in seven or six.

Q. You are standing on a wind with all your sails set; your enemy is in sight, standing towards you, how do you clear your ship for action?

A. I will call all hands to quarters, up hammocks, the quarter-masters to stow them in the netting, and on the gang-way; get the top-men's hammocks up in the top; down all chests in the hold; quarter-masters stow them; take in all the small sails; sling the lower yard with top-chains, get the puddings and dolphins up; then sling the top-sail yards half mast or close up; stopper the top-sail sheets, stoppers on the jeers, or else rack them; gunners get the match tubs between every two guns, matches, powder horns, crows, and handspikes, sufficient for every gun; all hands to quarters, keep silence and mind the word of command, fire not a gun until the word of command is given; mind you do not fire a shot in vain. Now I have all the three masts in one, Fire!

Q. Suppose you are in chase of an enemy's ship of war, upon a wind, with all your sails set; she is right a-head, on which side will you engage her?

A. I will engage her to leeward, by reason she cannot put away before the wind, and if there is any thing of a sea, she may not be able to fight her lower tier of guns. If light breezes and hot weather it would be better to engage to windward, to let them receive the smoak and heat of the fire.

Q. You are chasing from the wind, and carry away your main-top-mast, how will you proceed?

A. I would haul up the main-sail, and send hands up into the top with a rope or hawser, to clap on that part of the mast that hangs down, then cut the lanyards of the main top-mast shrouds, and lower way, cast off the hawser, reeve it to send the stump down, clear away the rigging, unsling the main-yard, get the foretackle on it and bowze forward the yard, then lower the stump upon deck, and get the spare top-mast ready for the cross-trees; clap the hawser on, and sway it up high enough for the rigging.

Q. You are lying to in a hard gale of wind under your main course, you carry away your main-mast, how will you proceed to clear the wreck?

A. I will clap my helm a-weather, brace my fore and fore-top sail yards full, then call all hands to get pole-axes, &c. to clear away the rigging.

Q. Why will you put the ship before the wind? *A.* Because

A. Becauſe the maſt will go a-ſtern clear of the rudder, and prevent its damaging the ſhip.

Q. You are going large and ſee a ſhip in the wind's eye, how will you proceed to chaſe her?

A. I will turn all hands up, get my tacks on board, brace up my yards and haul aft the ſheets; haul the bow-lines, ſet the jib and ſtay ſails, keep her full, and by making ſhort boards and turn directly to windward, which will prevent her putting away large.

Q. Suppoſe you were to carry away your bowſprit, what would you do?

A. I would immediately veer ſhip, and keep her before the wind; and then, for the ſecurity of the fore-maſt, I would carry forward the fore-runners and tackles, and bowze them well taut, till I can get a hawſer or ſufficient rope, and clinch it round the maſt-head, and ſecure it to the bits of the fore-caſtle or the cat-heads; then take the beſt ſpar I have and make a jury bowſprit of it.

Q. Having a fair wind, how will you ſet your fore-top-maſt ſtudding ſail on the larboard ſide?

A. Firſt haul taut the truſs tackles, and bowze the fore-yard cloſe to; then haul taut the larboard fore-lift, and ſtarboard fore-top-ſail clue-line; on board his Majeſty's ſhips the top burtons are on the top-ſail yards to keep them ſquare when ſtudding-ſails are ſet, (the top-ſails, lifts, and clue-lines not thought of) the fore top men down on the fore-yard, and rig out the larboard ſtudding-ſail boom, firſt ſending down the ſtudding-ſail tack and outer halyards, up to the fore-top-ſail larboard yard-arm; and reeve the halyards, ſend them down and bend them; the tack being bent and all ready, man the halyards and hoiſt away, haul out the tack, &c. If the wind is on the beam or quartering, ſet it abaft the top-ſail; if right aft, before the topſail, (which is done by a man ſtanding on the fore yard-arm, with the leach of the ſtudding-ſail in his hands.)

Q. Suppoſe you are in an engagement, and your main-top-maſt ſtay is ſhot away, how will you ſecure your maſt?

A. I will ſend my ſhifting back ſtay forward by the main-top-maſt ſtay-ſail halyards, and reeve it through a block abaft the fore-maſt head, bowſe it taut, and that will ſecure the maſt.

Q. Your ſhip comes to againſt her helm, what will you do?

A. I will haul my mizen up, and ſhiver the after-ſails.

Q. She comes to yet, if ſhe ſtays ſhe will be on board ſome other ſhip?

A. I'll let go the lee-fore and fore-top-ſail braces, raiſe the fore tack and let go the bow-lines, haul in the weather braces, and box her off.

Q. How do you ſplice your cables?

A. I will put the whole ſtrands of the beſt or ſmall bower cables twice each way, and point each ſtrand with a tail of three fathoms each; then ſeize them with quarter and end ſeizing to make them lie ſnug, which is the readieſt way for clearing the hawze. They being ſoon ſpliced and unſpliced when pointed.

Q. How would you mark the lead-line?

A. Black leather at 2 and 3 fathoms, white at 5, red at 7, black at 10, white at 13, (ſome ſeamen uſe black at 10 and 13) white at 15 as at 5, red at 17 as at 7, two knots at 20 fathoms, and ſo on, an additional knot at every 10 fathoms, with a ſingle knot between each 10 fathoms to mark the line at every 5 fathoms.

Q. You are ſent down in the dark for a top-ſail, how do you know a main-ſail from a fore-ſail, or a main-top-ſail from a fore-top ſail?

A. If it has three bow-line cringles it is a main-ſail; if it has but two,

it is a fore-sail: if it is marled abaft the foot rope, it is a main-sail, if before it is a fore-sail: if a main-top-sail, it has four bow-line cringles, if a fore top-sail but three: all top-sails are marked to the rope, because the foot rope is served.

Q. The sheers are along side, how do you get them in?

A. Par-buckle them in with their heads aft on the poop, and get the fore and main runners on them for guys; lash on two four-fold blocks, reeve the masting-falls, get girt lines on the head of the shears to steady the mast-head, put heel lashings on the shears, with good oak planks under them, to transport them forward on; lash one of the four-fold blocks forward to the stem, and bring the fall to the capstan; heave the sheers high enough: when done, I'll take forward two runners and tackles to assist the sheers, take the mizen-mast first in, then raise the sheers erect, take in the main-mast, bowse the heels of the sheers forward, and keep them upright to take in the fore-mast.

Q. How do you rig a lower mast?

A. I will lash on the girt-line-blocks, put on the bolsters, parcel and tar them, put over the runner and tackle-pendants, then the foremost of the starboard-shrouds, then the larboard, and so on; then the stay and spring stay, seize in the dead eyes for the shrouds, and the harts for the stay, reeve the lanyards, set up the rigging, get the top over head, and bolt it, rattle down the shrowds, and seize on the cat-harpin-legs, hook the futtock shrouds and hitch them, seize down the ends, lash the hanging jeer blocks under the top, with the strops under the stays, lead up and lash to the mast-head, get the cap into the top for the head of the top-mast, and lash the blocks on for the main lifts.

Q. How do you get a top and cap over?

A. Make fast a girt line block, on each side of the mast-head, reeve the girt-lines, and pass them under the top, and make them fast to the after-part of the top, stop them to the bolt holes in the middle and fore-part of the top, then sway away: when high enough, cut the upper stops, having a guy on the after part of the top-brim, and the top will fall over the mast-head, then lower away, and put it in its birth, haul upon the guy and bolt it, lay the cap steady over the trussel trees for the top-mast head, to receive it; when the top-mast-head is through it, lash the cap to the top-mast till high enough, then place the cap on the mast-head, and drive it down.

Q. How do you rig a main-top-mast?

A. I will tar the mast head, get the cross-trees over, fix the bolsters and parcel them, put over burton-pendants, then the shrouds, and back-stays, proper and spring-stay, and cap, sway up the mast and fid it, seize in the dead eyes, stay the mast, set up the shrowds, rattle them down, lash the bullock-blocks to the mast-head.

Q. How do you rig a top-gallant mast?

A. I will send down the top-rope, reeve it through the sheave hole, and make it fast round the hounds of the mast, and standing part of the rope, leaving enough end to make fast to the cap for doubling, put on a seizing about half way up, which done, sway away; when the head is through the cap, make fast the spare end or standing part of the top-rope to the cap, cut the seizing, clap on the grommet, then the shrouds, back-stays and stay, sway up the mast, fid it, and set the rigging up.

Q. How do you rig a bowsprit?

A. I will lash the collar for forestay, the bob-stays and bowsprit shrouds, then the collar for the spring-stays, then the block for the top-mast stay, fix the man-rope, gammon the bowsprit, and set bob-stays and shrouds up.

Q. How

Q. How do you rig a jib boom?

A. I will put over the traveller, horfes, and guys, the top gallant ftay-block, and lafh on the blocks for the top-gallant-bow line, and jib-down-haul-block to the traveller.

Q. How do you rig a lower yard?

A. I will get the yard athwart the gunwale, lafh the jeers, clue-garnets, bunt-lines, leach-lines, and flab-line blocks, then put over the yard-arms the horfes brace pendants, the yard tackle pendants, then the top fail fheet and lift blocks, reeve the jeers, braces, lifts, and yard-tackle falls, trufs parels, fway the yard up, haul all taut, and belay.

Q. How do you rig a fore top fail-yard?

A. I will reeve a hawfer for a top-rope, through the bullock block, and fend it down, and having put over the horfes, make the top rope faft to the middle of the yard, ftopping it to the yard-arm, fway it up above the top, put over the brace pendants and lift blocks, reeve the lifts and braces, cut the yard-arm feizing, and crofs the yard, lafh the tye, bunt-line, and clue-line blocks, reeve the tye and halyards, fway it up above the cap, and parel it, reeve the clue-lines, bunt-lines, and reef-tackles.

Q. How do you rig a top-gallant yard?

A. I will feize the clue-line-blocks on, put the horfes over the yard-arms, fway it up on the cap, and rig the yard-arms, by putting on the brace-pendants and lifts, then crofs the yard and parel it.

Q. You have loft your rudder at fea, what method will you take to fteer the fhip?

A. I will take a large fpar, or part of a top-maft, and cut it flat in the form of a ftern-poft, bore holes at proper diftances in that part which is to be the fore part of the preventer, or additional ftern-poft. then take the thickeft plank I have on board, and make it as near as I can into the form of a rudder, bore holes at proper diftances in the fore part of it, and in the after part of the preventer ftern-poft to correfpond with each other; and reeve rope grommets through thofe holes in the rudder and after part of the ftern-poft for the rudder to play upon.

Through the preventer ftern-poft reeve guys, and at the fore part of them fix tackles, and then put the machine over-board; when I get it in proper pofition or in a line with the fhip's ftern-poft, lafh the upper part of the preventer poft to the upper part of the fhip's ftern-poft, then hook tackles at or near the main chains, and bowfe taut on the guys to confine it to the lower part of the ftern-poft;—having holes bored through the preventer and proper ftern-poft, I will run an iron bolt through both, taking care not to touch the rudder, which will prevent the falfe ftern-poft from rifing up or falling down.

By the guys on the after part of the rudder, and tackles fixed to them I may fteer the fhip. I muft take care to bowfe taut the tackles on the preventer ftern-poft to keep it clofe to the proper ftern-poft.

Q. Your fhip is leaky, you cannot keep her free by the pumps, what will you do.

A. I will take a fpare top-fail, or fome other fail, and fpread it upon the deck, cover it all over with oakum, and bind it to the fail with a needle and twine in feveral places, to keep it faft to the fail, then take an hawfer and cut it into proper lengths to go under the fhip's bottom, and come in over the gunnel, put thefe hawfers about four feet diftant under the fail, and make them faft with their middle to the middle of the fails, and each leach beginning at the head and leaving off at the clues:—Then put the fail over board, keeping the oakum fide to the fhip's bottom, and haul up the ends

of the haufers on the other fide by a hauling line which I have fwept the fhip with, numbering each end fore and aft; then eafe away on the hawfer's ends on that fide I have put the fail over, and keep hauling at the fame time on the hawfer's ends on the oppofite fide when the fail is properly down, which is known by marking the hawfer; I will then clap on tackles and bowfe all taut, keeping the fail clofe to the fhip's bottom, the oakum will be drawn in, and ftop the leak. The fail may be covered with dung, or any filth I have on board, which will be drawn in and ftop the leak.

Q. Suppofe the wind northerly, and you are in a fhip's hawfe in the Downs, what would you do?

A. I would wait until the fhip tends to windward, and heave up my anchor as fhe is tending.

Q. How would you work a fhip out of the Downs with the wind foutherly?

A. I would ftand to the Goodwins and in 10 or 11 fathoms, it being fteep to; and to the fhore in 8 fathoms water.

Q. Is there any danger in going out of the Downs?

A. Yes; between Deal and Walmer Caftle there are fhoals near the fhore, not having more than 16 or 17 feet of water on them at fpring tides; as I draw towards the Foreland, I would ftand in fhore, to 10 or 9 fathoms, and off to the South Sand-head, Upper Deal and Walmer Caftles in one will lead me clear off; Deal Church being open with Walmer Caftle about a fhip's length, I muft ftand out till I bring the lights in one, then I am clear of the South Sand-head; and when the light-houfe opens to the weftward of Folkftone Church with Hay Cliffs, it leads me clear. I muft take care not to fhut in the Hope-land, and the South Sand-head will lie off three miles.—To fail out of the Downs to the weftward, and the wind at S. W. I will begin to unmoor at a quarter flood, weigh at high water, and caft her in fhore. But to fail to the eaftward with the wind wefterly, I would begin to unmoor at half ebb, take up my beft bower, and weigh at low water.

Q. The wind at N. E. in moderate weather you mean to turn up the Swin, at what time of the tide would you weigh?

A. At flack water, loofe the fails and up anchor.

Q. What are the marks for running through the Gull Stream?

A. To keep the upper light-houfe on the South Foreland, in one with the wefternmoft end of the fouthernmoft cliff in Old Stains Bay; which is a fwamp that lies between the two cliffs a large half-mile to the fouthward of Kingfdown upon the South Foreland.

Q. How do you know when you can weather the South Sand-head?

A. When Upper Deal Mill is open to the fouthward of Walmer Caftle, or when the light-houfes are in one, and Folkftone Church is open with Hay-Clift, I am clear.

Q. Suppofe you were coming into the Downs with the wind at S. W. blowing hard, which way would you lay your fhip's head to bring her up?

A. I would lay the fhip's head to the eaftward, and come to with my beft bower, but if with the fmall bower, I would have her head in fhore.

Q. For what reafon would you do fo?

A. I fhould then keep the cable clear of the cutwater.

Q. What is the courfe from the South Foreland to Dungenefs, and what are the dangers?

A. From the South Foreland to Dungenefs, the true Courfe is S. W. by W. ½ W. diftance 23 miles.

The

The Ripraps lie N. E. and S. W. about 5 leagues in length; the N. E. end bears from Dover Castle S. S. E. 4 leagues, from Folkstone S. E. by S. Calais steeple bears from it S. E. and Calais Cliffs S. S. E. 3 leagues, the S. W. end bears from Dungeness E. S. E. 4 leagues, on the N. E. part there are about 15 or 16 feet at low water, on the S. W. end 4 or 5 fathoms; it is steep to on both sides, having 20 and 22 fathoms close to it. To the westward of Folkstone, there is a ledge of rocks that runs a large mile off the shore, I would come no nearer in than 14 fathoms.

About 4 miles E. by N. from Dungeness, there is a shoal with not more than 12 feet on it, which I shall avoid by keeping in 10 fathoms.

Q. Where will you anchor, and in what depth of water under Dungeness?

A. I would anchor with the Ness Point S. W. by W. the light-house W. S. W. athwart Romney Town, in 8, 9, or 10 fathom water.

There is a shoal about two miles to the westward of the Ness, with only 18 feet on it at low spring tides, the Ness light bears from it N. E. by E. 12 fathoms close to.

Q. What is the course from Dungeness to Beachy-head, and what are the dangers?

A. W. ½ S. distance about nine leagues.

Off the highland of Farleigh there is a shoal of rocky ground with 14 feet on it, and lies pretty close in. In the channel off Dungeness, there is 24 fathoms, and off Beachy-head from 26 to 30 fathoms; I will, in thick weather, keep in 15 or 20 fathoms, from the Ness to Beachy-head. When I deepen my water, haul to the Northward, but if I shoal it, haul to the Southward. In clear weather I may stand in shore until Beachy-head bears W. by N. and not have less than 10 fathoms of water, must then tack to avoid Pemsey Shoal, which lies about two miles off the shore, with Pemsey Church bearing N. and Beachy-head W. by S. 14 feet on it.

There is a shoal with 14 feet on it, and lies with Beachy-head W. ½ N. 12 miles; E. by S. 6 miles from Beachy-head is the Horse of Willington, a small shoal, having 16 feet on it at low water.

Q. Being off Beachy-head, at the close of a winter's evening, in a gale of wind at N. E. bound to Spithead, what is best to be done?

A. I would lie to with my ship's head to the N. N. W. till morning, then she will drive about a channel course at the rate of two knots an hour, allowing that what she would lose in the ebb, she would gain in the flood, and be in a fair way in the morning; I would come no nearer to the Owers than 18 or 20 fathoms.

Q. What is the course and dangers between Beachy-head and Dunnose?

A. The course is W. by N. ¼ N. distance about 20 leagues.

The dangers are, Owers; the mark to go clear off the east part of them, is the white way on Crow Hill in one with Chichester Church, a little to the eastward of Pegham Church, and the mark to clear the west end, is St. Rook's Hill in one with Chichester Church, they bear from Culver Cliff E. S. E. ½ S. about 4 leagues; *there is a floating light just to the Eastward of them*; in going down Channel, if I keep Dunnose W. N. W. Northerly, will carry me without them, I will come no nearer to them in thick weather than 18 or 20 fathoms.

Q. You are coming from the Westward and off Dunnose, what would you do?

A. I would steer N. E. keeping Sandown Castle clear of Culver Cliff, bearing W. by N. then I may run in between Bembridge Ledge and the Princessa Shoal, but with a ship of a great draught of water, it is best to go without the Princessa Shoal, until I get the Kickergill on the S. W. part of

Monkton Fort, and run into Spithead between the Buoy of the Dean and the Buoy of the Warner.

N. B. In going for Spithead from the eastward, there are 5 black buoys lying on the Dean and Horse, they must be all left on the starboard side, the outer one is called the East Buoy of Dean, it lies in 27 feet water, the marks for it are the flagstaff of Portsmouth platform, a little open to the westward of a round sentry-box off South Sea Castle, bearing N. by W. ¼ W. with Dunnose open off Culver Cliff.

From the outer buoy to the next is W. N. W. about one mile and a quarter, it lies in 6 fathoms; the third lies in 4 fathoms; the buoy of the Warner bears west southerly from this buoy about 1¼ mile; from the third to the fourth or Elbow buoy, is S. E. and N. W.; it lies in three fathoms.

The Buoy of the Horse bears from the third buoy N. N. W. about 1½ mile, and lies in 3½ fathoms; from this last buoy to the first buoy of Sturbridge, the course is W. ½ N. the Royal George lies in 13 fathoms, ¾ of a mile to the N. W. of the Edgar, the buoy of the Royal George, that of Noman's Land, and the Kickergill, lie in a line.

The two buoys of the Princessa Shoal lie N. E. by N. and S. W. by S. of each other, distance about a mile; they lie each in five fathoms with 4½ between them, the marks for the inner buoy, which is white, are Sandown Castle in one with Culver White Cliff, and Nettlestone Point on Bembridge Point, the buoy of Bembridge Ledge is black, and the Nob buoy is red, they lie E. N. E. and W. S. W. of each other, with Dunnose open of Culver Cliffs.

Q. Suppose you were to the northward of Bembridge Point, bound to Spithead, and the buoys were all gone, what would you do?

A. I would bring St. Helen's Church to bear W. and keep in twelve fathoms and steer N. by W. towards the Dean, keeping Ashdown-mark above the trees, will lead me into Spithead, abreast of Ride; if it is thick weather and the wind southerly, I will come no nearer to Bembridge Ledge than six fathoms, and steer N. W. by N. but if the wind is on the other side, I would come no nearer the Dean and Horse than 10 fathoms; observing the course and tides, I will anchor at Spithead with South Sea Castle N. E. by E. and the Kicker Point N. W. in 14 fathoms, East Indiamen and merchant ships generally anchor on the Mother Bank to the westward of the Sturbridge-buoy in 10 or 15 fathoms; if I am obliged to turn into Spithead, I may turn the Kickergill on each side of Fort Monkton, and come no nearer the Warner than 12 fathoms, nor to the Dean than 9 or 10 fathoms, nor to Noman's Land than 16 or 18 fathoms, being close to it.

Q. How do you come to anchor at St. Helen's?

A. I would keep Sandown Castle just open of Culver Cliffs, and bring St. Helen's Church a sail's breadth open of the Red Cliffs of Bembridge Point, and anchor in 8 or 9 fathoms.

Q. Suppose you were moored at Spithead with a cable and an half on the best bower, and one on the small bower, you have orders to sail, at what time of the tide would you unmoor, and which anchor would you take up first?

A. I would begin to unmoor at the first of the flood, and take up my small bower first.

Q. In sailing within the Isle of Wight and through the Needles, what are your observations?

A. To keep clear of the West Middle, I would keep South Sea Castle a sail's breadth open of the Kicker Point until I open West Cowes Castle, then steer directly for Hurst Castle, and when abreast of it, borrow pretty near

near it, then steer for the Needles Point; the leading mark through the Needles is the Light-house in one with Hurst Castle, bearing N. E. by E. ¼ E. I must be careful to keep the vanes of the windmill which stands on the island in sight, to keep me clear of Warden Ledge; great regard must be had to the tides, for the flood sets on the Needles, and the ebb on the Shingles with great velocity. *N. B.* To the northward of the West Middle lies the Bramble; the Bramble and West Middle have each two buoys on them; if I sail to the northward of the West Middle, I must sail between it and the Bramble, leaving the Bramble on the starboard side; when I come to West Cowes Castle, I must give it a good birth, as there is a ledge of rocks that lie off it: Warden Rock lies on the Island Side with a buoy on it, when I come near the Needles, must give them a good birth to avoid the Chalk Rock *.

Q. What is your course from Dunnose to Portland?

A. W. by N. 18 leagues.

Q. If you are forced into Portland, what precautions are necessary?

A. I must take care of the shambles, they bear from Portland Lights, which lie north and south of each other; N. W. by W. 4 miles, with only 14 feet on them at low water; to sail into the Road from the westward, I must keep close to the Bill, and keep my lead going; when I am round the East Point, haul up and anchor against the Pier, in 9 or 10 fathoms, with the Bill bearing S. S. E. Portland Castle S. S. W. and Weymouth Castle N. W. In sailing out of Portland Road, I must keep Week Church open of the Stone Pier, and that will carry me clear to the eastward of the Shambles.

The tide flows hard from the Road to the Bill E. S. E. 7 hours, and the flood sets right of the Bill 9 hours.

N. B. In case I should be embayed to the westward of Portland, and no possibility of getting out between Burton and Chiswell, where it ebbs 9 hours and flows only 3 hours, there is a steep beach of pebbles, I would there run my ship on shore with as much sail as I could carry, especially at the beginning of an ebb, and remain on board for three or four seas, when I may get on shore with safety.

Q. What is the course from Portland to Torbay, and how do you anchor there?

A. The course is W. N. W. and distance about 14 leagues; to anchor in the bay, I would bring the Berry Head to bear S. by E. or S. S. E. and Brixham Church on with the Pier Head; the best anchoring for small ships is 1½ from Brixham Pier Head, in 7 fathoms, or just to the Eastward of Torpier.

Q. What is your course from the Berry Head to the Start

A. S. W. about 6 leagues.

Q. Is there any danger near the Start?

A. Yes, about two miles to the eastward of the Start, there is a shoal with not more than 9 feet on it, the Bolt Head being kept open of the Start Point, will carry me clear of it.

Q. What is your course from the Start to the Eddistone?

A. W ½ S. 7 leagues.

Q. What is your course from the Start to Ramhead?

A. W. N. W. 7 leagues.

Q. What is to be observed in sailing into Plymouth Sound?

A. If coming from the westward, and am got round the Ramhead, I must give Penlee Point a good birth, by reason of a ledge of rocks that lies

* For a more particular account, see the DIRECTIONS published by JOHN HAMILTON MOORE. Price 2s. 6d.

lies off from it, then haul N. N. E. ½ E. for anchoring; the leading mark in is Plymouth Church, on with the middle Obelisk on the Hoa.

In going into the Sound I may anchor in Cawsand Bay, in 20 fathoms, with Penlee Point S. W and the town of Cawsand W.N.W.

The leading mark to carry me in between the Knap and Shovel, is Plymouth old church, on with a white patch on the Hoa.

I may go into the Sound on the east side, between the Tinker and Shag-stone, by keeping Mount Batton a sail's breadth open of Staden Point, and keep in that direction until Maker's church bears N. W. and Withy Edge open, then haul over to the eastward and anchor.

Q. How do you sail into Hamoaze?

A. I would keep Kingsand open of Redding Point, until the large House at Stoke touches the East side of Mill Bay; steer in until the Obelisk comes on with Block House Point; keep in that direction, till the easternmost summer house on Mount Edgecomb Side comes open with the Point within which it stands; then steer for it, until the east point of Mount Wise comes open with Block-House Point; then steer mid-channel for Stone-house Pool till Drake's Island is shut within Block-House-Point: I must not open it till South Down comes open with the Obelisk, then steer up the harbour with the side of Drake's Island, just touching Passage Point, which will lead me to the southward of the Harbour shoal, on the outer part of which there is a rock, with only sixteen feet on it, but on any other part, there is a 3½ fathoms.

N. B. The marks to know the Sound when I am coming from sea in the day time, are, Ram Church, which stands to the northward of the Ram-head, and a square tower standing on the highest part of the land.

Q. You are bound into Falmouth, how would you proceed?

A. In going to Falmouth, there is a rock, called the Block Rock, with a pole on it, and shews itself at half tide; it lies nearest to the west shore; I may sail in on either side of it, but the east side is the best. If I would sail into Carrick Road, I must keep in the fair way, and my lead going, as there is a narrow deep channel all the way, of 16 or 18 fathoms. I may borrow on St. Maw's side in 5 or 6 fathom. The best anchoring in Carrick Road, is St. Maw's Castle E.S.E. and lay my easternmost anchor in 16 or 18 fathoms, and my westernmost anchor in 4 or 5 fathoms. Just past St. Maw's there is a sand that is steep to, called St. Maw's Sand, and lies almost half channel over.

N. B. Great ships anchor, with Manacle Point, on with the point of Falmouth, or a great house, that is to the westward of Penryn, just open Trefusis Point in 18 fathoms.—The Manacles lie from Falmouth about S.S..

Q. How do you know the Lizard when you first make it?

A. It is the southernmost land on the coast, and may be seen 7 or 8 leagues off, in 42 fathoms.

Q. How does the Land's End appear when you make it?

A. It appears in hummocks with a church on it, and may be seen 7 or 8 leagues off, in 54 fathoms.

Q. What are the dangers off the Land's End?

A. Many:—1st, The Runnel-stone lies about nine tenths of a mile S. S. E. from Tol-peden-penwith.

2d, N. E. by N. from the Runnel-stone there is a rock, called the Leawmean, which appears at half ebb, with a passage between it and the main, seldom used by any but by coasters. 3d.

3d, The Wolf Rock; bears from Tol-peden-penwith W. S. W. diſtance 7 $\frac{1}{4}$ miles; it is ſmall and may be ſeen at half tide; the largeſt of the Breſam Rocks, kept open of the outermoſt of the Long Ships *(on which there is a light-houſe erected)* will lead me clear to the weſtward of the Wolf.

4th, The Long Ships lie N. W. by N. about 3 miles from the S. W. point of the Land's End, and 1 mile W. N. W. from the weſternmoſt point; they are high, and may be ſeen 4 or 5 leagues off.

5th, The Kettle-bottom, is a ſhoal with only 6 feet on it, and lies about half-way, between the northernmoſt part of the Long Ships, and the weſt point of the Land's End.

6th, The Breſam rocks lie about 3 miles N. E. by N. $\frac{3}{4}$ E. from the Long Ships.

7th, The Seven Stones are a row of rocks that come not above water, but the ſea always breaks over them; they lie from Cornwall W. $\frac{1}{2}$ S. diſt. 5 $\frac{1}{2}$ leagues; and from St. Martin's Head, Scilly, N.E. diſt. 3 leagues.

Q. If you are forced into Mount's Bay, where would be the ſafeſt anchoring ground?

A. Mount's Bay lies between the Lizard and the Land's End; there is a high Iſland on the eaſt ſide, and a Caſtle on the weſt ſide of it, called St. Michael's Mount; from the eaſt ſide of it lies a ledge of rocks, near a league into the ſea; the Coaſt is full of rocks, and not ſafe to anchor in. To ſail into the Bay I muſt bring St. Paul's ſteeple W. and keep over to the weſt ſhore, and make St. Clement's Iſland, which is before the town of Mouſehole, having the caſtle on the ſtarboard ſide; I ſhall then ſee a large ſandy bay, and, when within the Iſland, there is a good anchoring in 7 or 8 fathoms.

Q. If you are bound, or forced to go into Scilly, what would you do?

A. I would ſteer for St. Mary's Sound, and run in for the ſouthernmoſt Point of St. Mary's Iſland, called Penninis Point, minding to keep the lead going, and approach no nearer than 5 fathoms water; about N. W. of Penninis Point, a little more than half a mile, is the Woolpack, the ſhoal lies near to the ſhore; I muſt continue to run in 5 or 6 fathoms, keeping pretty cloſe to St. Mary's Iſland, to avoid the Spaniſh Ledge, which lies about half a mile W. by S. from Penninis Point; ſome part of this ſhoal may be ſeen at low water, and part of the Woolpack ſhews itſelf before low water; when I have got abreaſt of the Woolpack, to which I muſt give a good birth, about a cable's length, and ſteer for the Stevel Rock which is bold to; when I am abreaſt of the Stevel, muſt ſteer N.W. by W. until Little Crow Iſland comes on with Bantſcarren Point; then ſteer N. N. E. until Crow Iſland comes open a ſhip's length of Bantſcarren Point, or bring the caſtle, which is on St. Mary's Iſland, to bear S. S. E. and anchor in 6 or 5 fathoms water.

THE

THE METHOD OF EXERCISING MERCHANT SHIPS COMPANIES FOR WAR.

IT is not presumed, in the following pages, to offer any hints to the officers in the Royal Navy, who may be said to be trained up in the school of war: we only attempt the humbler task of suggesting a few observations to the commanders of merchant ships, who, occupied in commercial pursuits in the time of peace, are sometimes deficient in the method of defending themselves when attacked in time of war. We would first recommend to station their crews according to their rank and capacities, by forming a quarter bill, and to exercise them in their respective stations. As merchant ships are so variously fitted out with guns and men, it is impossible to form a quarter bill to suit all. We have, however, given two quarter bills, one for a trading ship of fourteen six-pounders, and fifty men, and the other for a privateer of twenty nine-pounders, and 160 men, which may be varied as circumstances and the difference of guns, carriages, and men may require.

A Quarter Bill for a Trading Ship of Fourteen Six-pounders and Fifty Men.

The captain to command in chief, on the quarter deck, if it be fortified to afford common shelter from small arms	1
The chief mate to command the six foremost guns, and work the ship forward	1
The second mate to command the eight aftermost guns	1
The boatswain to pass the word, and get the captain's orders executed fore and aft, as occasion may require	1
The carpenter to attend the pumps, shot-plugs, &c.	1
The gunner to deliver the powder to the boys, as carriers	1
The doctor in the lowest, safest, and most convenient place the ship affords	1
A good man at the helm	1
Four men to each gun and its opposite, and a boy to fetch powder	35
Seven men at small arms and occasional duty	7
	50

A Quarter Bill for a Privateer of Twenty Guns, Nine-pounders, and Four Three-pounders on the Quarter-Deck and Forecastle.

The captain to command the whole	1
The master to assist and work the ship according to orders	1
A midshipman to pass the word of command fore and aft	1

A quarter

A quarter maſter at the con, and another at the helm . . .	2
The firſt marine officer with 24 muſketeers	25
Three men for the two three-pounders, and a boy to fetch powder	4

On the Main Deck.

The firſt lieutenant to command the ten foremoſt guns . . .	1
The ſecond lieutenant to command the ten aftermoſt guns . .	1
The gunner to aſſiſt and attend all the great guns fore and aft . .	1
The two maſters mates to attend the fore-top-ſail braces, and work the ſhip forward according to orders	2
The boatſwain's mate, with two ſeamen, to aſſiſt in working the ſhip, and to repair the main rigging	3
The carpenter and his crew to attend the pump, and the wings about the water's edge, fore and aft, with ſhot-plugs, &c. . .	4
Six men to each of the ten guns on a ſide, and its oppoſite, and a boy to fetch powder	70

On the Forecaſtle.

The boatſwain to command, with two ſeamen to work the ſhip and repair the fore rigging	3
Three men, and a boy to fetch powder, for the two three-pounders	4
The ſecond marine officer, with nine muſketeers	10
In the barge upon the booms, the third marine officer with eight muſketeers	9
In the main top, five men with a midſhipman at ſmall arms, and to obſerve the conduct and condition of the enemy	6
In the fore top, five men at ſmall arms and to repair the rigging	5
In the mizen top, three men at ſmall arms and to repair the rigging	3
In the powder room, the gunner's mate with an aſſiſtant to fill and hand powder to the boys, carriers	2
In the cock-pit, the doctor and his mate	2
	160

Here it may not be amiſs to remark, that the people ſhould be quartered to fight neareſt to where they are ſtationed to work the ſhip; that is, the after guard on the quarter deck, the waiſters in the waiſt, forecaſtle men that are neceſſary in the forecaſtle, &c. The quarter bill and diſcipline of the crew ſhould be kept from diſorder as long as poſſible; and when occaſional duty requires the people to be let go from their quarters, it ſhould not be done at random, but with judgment, ſuch as will ſuit the occaſion, from the muſketeers, or a man from each great gun, &c. where they can be beſt ſpared.

On Preparing for Exerciſe or Action.

When all hands are called to quarters, every man ſhould bring his

hammock well lafhed up, and ftow it to the greateft advantage to give fhelter from fmall arms neareft to his own quarters, or give it to fome of his meffmates where they are moft wanted, that they may know readily where to find them when exercife or action is over.

When the hammocks are properly ftowed, the officers, according to their ftations and duties, are to fee the fhip effectually cleared of all incumbrances, and every thing prepared, fo that nothing may be wanting that is neceffary for exercife or action.

The lieutenants or mates, with the gunner on the gun deck, are to get all the hatches laid, except that where the powder is to be handed up; a match tub half filled with water, and four matches in the notches, placed as near midfhip as poffible to ferve two guns and their oppofites; alfo fwabs to wet the decks, to prevent the fatal confequences that may attend the fcattered and blown powder from the priming of the guns making a train fore and aft, which has, in many inftances, taken fire from the firing of the guns, and done great damage. It is further the duty of the lieutenants to fee that the captain of each gun has his men, powder-horn, rope-fponge, rammer, crows, handfpikes, and train tackles, all ready in their proper places.

The boatfwain muft get the yards flung, the topfail fheets ftoppered, and marline fpikes ready to repair the ftanding or running rigging that may be damaged.

The carpenters are to get the pumps rigged, and fhot plugs, with all that is neceffary, ready in their proper places, to ftop leaks and repair damages.

The gunner, when preparing for action, is to fee that the charges in the guns are dry, and that there is a fufficient quantity of wads, and fhot of all forts, and cartridges ready filled.

The marine officers are to fee all the mufketeers at their quarters, with their arms and ammunition in good order for exercife or action.

Exercife of the Great Guns.

1 Silence	8 Fire
2 Caft loofe your guns	9 Spunge your guns
3 Level your guns	10 Load with cartridge
4 Take out your tompions	11 Shot your guns
5 Run out your guns	12 Put in your tompions
6 Prime	13 Houfe your guns
7 Point your guns	14 Secure your guns.

1. Silence.

At this word every one is to obferve a filent attention to the officers.

2. Caft loofe your Guns.

The muzzle lafhing is to be taken off from the guns, and, being coiled up in a fmall compafs, is to be made faft to the eye-bolt above the port, the lafhing-tackles at the fame time to be caft loofe, and the middle of the breaching feized to the thimble of the pomillion. The fpunge to be taken down, and with the crow, handfpike, &c. laid upon the deck by the gun.

N.B. When prepared for engaging an enemy, the feizing within the

the clinch of the breaching is to be cut, that the gun may come sufficiently within board for loading, and that the force of the recoil may be more spent before it acts upon the breeching.

3. Level your Guns.

The breech of your metal is to be raised, so as to admit the foot of the beds being placed upon the axle-tree of the carriage, with the quoin upon the bed, both their ends being even one with the other.

N. B. When levelled for firing, the bed is to be lashed to the bolt which supports the inner end of it, that it may not be thrown out of its place by the violence of the gun's motion, when hot with frequent discharges.

4. Take out your Tompions.

The tompion is to be taken out of the gun's mouth, and left hanging by its laniard.

5. Run out your Guns.

With the tackles hooked to the upper bolts of the carriage, the gun is to be bowsed out as close as possible, without the assistance of crows or handspikes; taking care at the same time to keep the breeching clear of the trucks, by hauling it through the rings; it is then to be bent so as to run clear when the gun is fired. When the gun is out, the tackle-falls are to be laid along-side the carriages in neat fakes, that when the gun, by recoiling, overhauls them, they may not be subject to get foul, as they would if in a common coil.

6. Prime.

Take off the apron and unstop the touch-hole, that the cartridge may be pierced with the priming-wire, and the touch-hole filled with powder, the pan also is to be filled; and the flat space, having a score through it at the end of the pan, is to be covered, and this part of the priming is to be bruised with the round part of the horn. The apron is to be laid over, and the horn put up out of danger from the flash of the priming.

7. Point the Guns.

At this command the gun is, in the first place, to be elevated to the height of the object, by means of the side sights; and then the person pointing is to direct his fire by the upper sight, having a crow on one side, and a handspike on the other, to heave the gun by his direction till he catches the object.

N. B. The men who heave the gun for pointing are to stand between the ship's side and their crows or handspikes, to escape the injury they might otherwise receive from their being struck against them or splintered by a shot; and the man who attends the captain with a

match is to bring it at the word, "Point your guns;" and, kneeling upon one knee oppoſite the train truck of the carriage, and at ſuch a diſtance as to be able to touch the priming, is to turn his head from the gun, and keep blowing gently upon the lighted match to keep it clear from aſhes. And as the miſſing of an enemy in action, by neglect or want of coolneſs, is moſt inexcuſable, it is particularly recommended to have the people thoroughly inſtructed in pointing well, and taught to know the inconveniences of not taking proper means to hit their mark; therefore they ſhould be made to elevate their guns to the utmoſt nicety, and then to point with the ſame exactneſs, having caught the object through the upper ſight. At the word,

8. Fire,

The match is inſtantly to be put to the bruiſed part of the priming; and when the gun is diſcharged, the touch-hole is to be ſtopped, in order to ſmother any ſpark of fire that may remain in the chamber of the gun; and the man who ſpunges is immediately to place himſelf by the muzzle of the gun in readineſs, when at the next word,

9. Spunge your Guns,

The ſpunge is to be rammed down to the bottom of the chamber, and then twiſted round, to extinguiſh effectually any remains of fire; and when drawn out to be ſtruck againſt the outſide of the muzzle, to ſhake off any ſparks or ſcraps of the cartridge that may have come out with it, and next its end is to be ſhifted ready for loading; and while this is doing the man appointed to provide a cartridge is to go to the box, and by the time the ſpunge is out of the gun, he is to have it ready; and at the word,

10. Load with Cartridge,

The cartridge (with the bottom end firſt, ſeam downwards, and a wad after it) is to be put into the gun, and thruſt a little way within the mouth, when the rammer is to be entered; the cartridge is then to be forcibly rammed down, and the captain at the ſame time is to unſtop the touch-hole, and keep his priming-wire in the touch-hole, and, feeling the cartridge, is to give the word *home*, when the rammer is to be drawn, and not before. While this is doing, the man appointed to put in a ſhot is to provide one, or two, according to the order at that time, ready at the muzzle, with a wad likewiſe, and when the rammer is drawn, at the word,

11. Shot your Guns,

The ſhot and the wad upon it are to be put into the gun, and thruſt a little way down, when the rammer is to be entered as before. The ſhot and wad are to be rammed down to the cartridge, and there have a couple of forcible ſtrokes, when the rammer is to be drawn, and laid out of the way of the guns and tackles, if the exerciſe or action is continuing, but, if it is over, the ſpunge is to be ſecured in the place it is at all times kept in, the ſtopper put in the touch-hole, and the apron put on.

12. Put

12. Put in your Tompions.

The tompions to be put into the muzzle of the cannon.

13. Houſe your Guns.

The ſeizing is to be put on again upon the clinched end of the breeching, leaving it no ſlacker than to admit of the guns being houſed with eaſe. The quoin is to be taken from under the breech of the gun, and the bed, ſtill reſting upon the bolt, within the carriage, thruſt under, till the foot of it falls off the axletree, leaving it to reſt upon the end which projects out from the foot. The metal is to be let down upon this. The gun is to be placed exactly ſquare, and the muzzle is to be cloſe to the wood, in its proper place for paſſing the muzzle-laſhings.

14. Secure your Guns.

The muzzle-laſhings muſt be firſt made ſecure, and then with one tackle (having all its parts equally taut with the breeching), the gun is to be laſhed. The other tackle is to be bowſed taut, and by itſelf made faſt, that it may be ready to caſt off for laſhing a ſecond breeching.

N. B. Care muſt be taken to hook the firſt tackle to the upper bolt of the carriage, that it may not otherwiſe obſtruct the reeving of the ſecond breeching, and to give the greater length to the end part of the fall. No pains muſt be ſpared in bowſing the laſhing very taut, that the guns may have the leaſt play that is poſſible, as their being looſe may be productive of very dangerous conſequences. The quoin, crow, and handſpike, are to be put under the gun, the powder-horn hung up in its place, &c.

Being engaged at any time when there is a large ſwell, a rough ſea, in ſqually weather, &c. as the ſhip may be liable to be ſuddenly much heeled, the port tackle-fall is to be kept clear, and (whenever the working of the gun will admit of it) the man charged with that office is to keep it in his hand; at the ſame time the muzzle-laſhing is to be kept faſt to the ring of the port, and being hauled taut, is to be faſtened to the eye-bolt, over the port-hole, ſo as to be out of the guns way in firing, in order to haul it in any time of danger.

This precaution is not to be omitted, when engaging to windward, any more than when to leeward, thoſe ſituations being very ſubject to alter at too ſhort a warning.

A train-tackle is always to be made uſe of with the lee-guns, and the men ſtationed to attend it are to be very careful in preventing the guns running out at an improper time.

THE METHOD OF ATTACKING OR DEFENDING A SHIP.

AS ſoon as the ſhip has got to ſea, I would recommend to take the firſt favourable opportunity to have all hands called to quarters, *the officers in their* ſtations to have every thing made properly ready

and fit for action; to have a general exercife not only of the great guns and fmall arms, but the method of working and managing the fhip, to take advantage of the openings which often occur in attacking or being attacked by another fingle fhip, which fhould be ftudied by every commander, and the defigned manœuvres fhould be taught the people in their general exercife, that they may know how to act and move regularly from one place and fide to the other as occafion may require, without confufion, which is always the cafe, when the intended manœuvres are not made known to the people.

For thefe reafons, as foon as poffible, it fhould be made known to them, that if a fhip of nearly equal force fhould bring too with a defign to fight, it was intended not to run directly along fide, and lie too like a log and depend upon mere battering with one fide only, or upon the ftern chafe guns. Begin the attack upon the weather quarter, fhooting the fhip up in the wind, with the helm a-lee, till the after lee gun, with which you fhould begin, can be brought to bear upon the enemy's ftern, then fire the lee broadfide. Immediately boxhaul the fhip round on her heel, fo as to bring the wind fo far aft, that the fhip may be fteered clofe under the enemy's ftern, giving particular orders to begin with the foremoft gun to rake them right fore and aft, as they pafs in that line of direction, all aiming and firing to break the neck and cheeks of the rudder's head, the tiller ropes, blocks, &c. fo as if poffible to deftroy the fteering tackle, which defign, if it proves fuccefsful, takes the management of their fhip from them, fo that fhe muft lie helplefs for a time in fpite of their endeavours.

When the aftermoft gun is fired, put the helm hard a weather to bring the fhip to the wind on the other tack, to keep clear of their lee broadfide, and act according to their motions, and the experience of the effect your attack has had upon them. If they continue to lie too, either renew the attack again in the fame manner as foon as the fhip will fetch the weather quarter again, or make fail off to efcape, if it is found that the great inequality of their fuperior force admits of no poffible chance of conquering them. And although this manœuvre may not have given this advantage (which in my opinion ought always to be attempted, and not to fubmit tamely although a fhip is doubly the force) yet the power of their broadfides may be chiefly avoided by it.

But when the inequality of force is not fo great but there is a poffibility of conquering, and if the fuccefs of the firft attack is perceived to oblige the enemy to continue lying too in order to repair the damage done their rudder or tiller, &c. then the blow fhould be followed, by renewing the attack again with all poffible expedition, in the fame manner, which gives the opening not only to fire the whole round of great guns to advantage, but alfo to the marines and topmen to fire their fmall arms at the fame time to great advantage, fo as to do the moft execution poffible, by firing and raking them fore and aft through their moft open and tender part, the ftern, with the leaft rifk poffible from the enemy's guns, and therefore gives the greateft poffible chance to make an eafy conqueft, efpecially if fo lucky as to deftroy and prevent the recovery of their fteering. A fhip of much fuperior force may be brought to fuch a diftreffed condition, as to be obliged to make a fubmiffion for want of the helm to command her, therefore when an opportunity offers in fighting this fhould be always aimed at.

But ſuppoſe the enemy laid too as above mentioned, find themſelves not much hurt by this manœuvre, and that you have not ſucceeded in deſtroying their ſteering, and therefore you may expect that they will immediately tack or wear ſhip, and ſtand after you, depending upon their ſuperior ſailing and force, ſhall run up along your lee ſide, expecting, by making a general diſcharge of their ſmall arms and great guns on your deck, which lies open to them by the ſhip's heeling to deſtroy your people, and to make you ſubmit: when this is likely to be their deſign, orders ſhould be given to your people, to keep themſelves as cloſe under ſhelter as poſſible from their ſmall ſhot until their general diſcharge is over; then if the ſhip is found not ſo diſabled, but that the topſails can be thrown aback, make a general diſcharge from the lee ſide of the great guns, loaded with round ſhot only, pointed to the weather ſide of the enemy's bottom amidſhips, to one point at the water edge, and boxhaul the ſhip to run cloſe under their ſtern, aiming at raking and deſtroying their ſteering with the other broadſide; then ſtand off on the other tack, and act according to circumſtances and the condition you find yourſelf in compared with the appearance of the enemy and their motions, who may be obliged to continue on the other tack to repair damages.

But when the enemy's ſhip of force makes only a running fight, and you have the advantage of ſailing faſter, the moſt ſure and likely method to make an eaſy conqueſt, is to run cloſe up, and ſhoot or ſheer your ſhip acroſs their ſtern each way, making a general diſcharge of all your force, aiming with the great guns at the rudder head and ſteering tackling; and you will have this advantage, that if the ſhot miſs the rudder head by raking the ſhip fore and aft through the ſtern, they may do the greateſt execution poſſible to diſtreſs the enemy, ſo as to make a ſubmiſſion. On this occaſion, when it blows freſh, and you are obliged to carry a preſſing ſail large or before the wind, to make the great guns as ready as poſſible, and prevent their being fired too low, all their breeches ſhould be laid quite down in the carriage, and if your ſhip is crank the yards ſhould be braced ſo as to ſhiver the ſails at the time each broadſide is fired. In all theſe manœuvres, where the whole round of great guns are deſigned to be fired, two or more men ought always to be left to load each gun again when fired on one ſide, whilſt the others move over again to fire the oppoſite, that neither ſide may be left unguarded.

Theſe or any other manœuvres may be taught the people, by heaving a tight empty beef caſk over-board, and making it the object of attack. Nor would I adviſe to ſpare a little powder on theſe occaſions, as a little expended in exerciſe may ſave a great deal fired to no purpoſe in action. Two ſhips ſailing in company afford an excellent opportunity of exerciſing manœuvres.

Note. At the end of this work are given two Tables; one ſhewing the proportion of powder for ſea guns, the other the number of ſhot contained in different ſized grapes.

ON SHIPS IN DISTRESS.

SUDDEN diſtreſs of ſhips has often ſtruck their crews with ſuch panics, as to occaſion them, in many inſtances, to take the worſt inſtead of the beſt means or methods for their ſafety or relief. It will

not, therefore, I truſt, be unacceptable to endeavour to point out every thing that may be of ſervice on theſe melancholy occaſions, as far as circumſtances and ſituations can be conceived to happen.

When a ſhip proves weak and works the oakum out, ſo as to make dangerous leaks between wind and water, it has been frequently practiſed to nail ſheet lead upon the ſeams, which is ſubject to break by the ſhip's working. Leather or canvaſs nailed on ſlack, with oakum under, will anſwer the purpoſe much better. In caſes where ſhips have worked their frames looſe, it has been frequently practiſed with ſucceſs, to take ſeveral turns of a hawſer or cable round them, and to heave theſe turns well taut, to prevent foundering.

Should a dangerous leak ſuddenly break out, as ſoon as the pumps are manned and ſet to work, the utmoſt endeavours ſhould be immediately uſed, and all poſſible means tried, to find out and ſtop the leak, before the people become exhauſted by continual pumping; when diſcovered, I would recommend fothering; for a deſcription of which ſee page 305 of this work.

To recover and get a Ship upright from being overſet or laid on her Side at Sea.

This is certainly a taſk that deſerves the utmoſt attention. If ground is to be reached by any means, the lee anchor or anchors ſhould be immediately let go, in order to bring the wind upon that bow that is laid down; that the wind may act upon the maſts and ſails, which may be ſet ſo as to bring the ſhip upright again. But in deep water, where anchors can be of no ſervice, it is recommended, if a towline, hawſer, or cable end can be readily come at, and if the driver boom, hencoops, or any other bulky things can be ſlung by the middle with ropes, and made faſt to it, that they be veered away with a long ſcope over the lee-quarter, to make ſuch great ſtop-waters as to make the ſhip wear, and bring the wind on the quarter that is down, that the ſhip may be brought to, on the other tack, and the ſails trimmed, ſo as to get her upright again without cutting away the maſts, which nothing can juſtify but the utmoſt neceſſity, to ſave a ſhip from foundering, becauſe of the great diſtreſs it brings her under for want of her maſts, eſpecially her lower maſts, when ſhe has a long run to her deſigned port, or to a place where ſhe can get this great damage repaired.

To make a Ship wear and ſteer that has loſt her Foremaſt.

THIS may be done by veering a hawſer or cable end over the lee quarter, but without any ſtop waters, only the nun buoy or any ſpare ſpars laſhed along it to buoy it from taking the ground, in caſe of coming into ſhoal water with little wind. This will act with great power with the helm, to make the ſhip wear and ſteer at pleaſure. And a ſpare yard or boom may be rigged out abaft the mizen ſhrouds to guy the cable to leeward in proportion to the ſhip's griping; and when ſailing before the wind to ſecure it over the middle of the ſtern, will prevent the ſhip broaching too againſt the helm both ways.

On Steering a Ship that has loſt her Rudder.

I would propoſe on this occaſion a hawſer or cable end with the nun buoys, ſpare ſpars, &c. laſhed along it, to buoy it up, in caſe of coming

coming into ſhoal water, and a boom rigged out on each ſide, cloſe aft athwart the ſtern, with a block on each at equal diſtances, as far as they can be ſupported from the ſtern, and a block on the rail or gunnel exactly oppoſite the middle of the wheel barrel, where the ſteering rope, marked with a rope yarn in the middle, is to be taken with three or five turns round the wheel, when the midſhip ſpoke and the mark on the rope are right up; then the two ends to be paſſed acroſs from the under part of the wheel, and reeved through the blocks on each ſide, and made faſt to the hawſer or cable that is towed a-ſtern exactly amidſhips, and as tight as it can well be to go clear of the ſtern; and then veer and heave freely from ſide to ſide, as the ſteering of the ſhip, with the trimming of the ſails on this occaſion, may require.

[See the Plate and deſcription of Captain Peckenham's Makeſhift Rudder, publiſhed in the 7th volume of the Tranſactions of the Society of Arts, Manufactures and Commerce, which is earneſtly recommended to the attention of all Commanders.]

On preſerving Boats from foundering when Ships founder.

SLING any maſt, yard, or ſpar, the longer the better, by each end, the bight of the ſpan to be twice the length of the boom; bend the boat rope exactly in the middle of the bight of the ſpan, which need not be above 10 fathom long: let your boat drive end on under the lee of this boom, which will break off the violence of the ſea from her.

On a ſhip being near a dangerous Lee-ſhore.

TO keep a ſhip off a dangerous lee-ſhore, every effort of mind and body ſhould be exerted, as being the only chance to ſave the lives of the crew and property on board. Carrying ſuch ſail as will give her good way through the water upon a wind, as long as ſhe will carry it, is certainly the beſt method to effect this purpoſe; it is alſo adviſable to reduce all tophamper that holds wind as much as poſſible; for if the ſhore proves ſo deep, or the bottom ſo rocky, as not to afford ſafe anchorage, their ſafety may depend entirely on carrying ſail.

Suppoſe in this ſituation it is found that the ſhip will not clear the ſhore on either tack, and after the utmoſt endeavours ſhe is perceived to loſe ground; but as there is no anchorage, there is no other means but to continue turning to the laſt, as the wind may abate, or may vary or change in your favour, even when you think it is the laſt tack you can poſſibly make before you muſt inevitably go on ſhore.

But when it happens that there is clear anchoring ground at a good diſtance from the ſhore, and ſailing proves ineffectual to keep clear of it, then the chief dependence muſt be upon the ground tackle applied to the beſt advantage.

Suppoſe then the ſhip to be properly prepared, and to have let go a kedge anchor and tow-line bent like a buoy-rope to the crown of the ſtream-anchor, and the inner end of the ſtream-cable bent to the crown of the beſt bower or ſheet-anchor, with a long ſcope of cable to make the ſhip ride ſafe and eaſy: where it is known, or found by ſounding with the lead armed with tallow, that the ground is foul, then no more cable ſhould be veered out than neceſſity requires to bring the ſhip up, to ride with as ſhort a ſcope as poſſible, becauſe the cable is liable to be cut or chafed; if that happens there is then the more room

aftern, and a better chance for a fecond or third anchor, trying to the laft moment all poffible means to keep the fhip from the fhore.

Where the water is fo deep that the anchoring ground lies but a little more than a cable's length from the fhore, then all the anchors fhould be let go to the beft advantage. To put this difficu't performance in practice, I would recommend to get the fquare fails handed with all poffible difpatch, but to keep the fore topmaft, main, and mizen ftay-fails fet, the yards braced full, and the helm put hard a weather to keep headway upon the fhip, fhooting her along the fhore as much as poffible till all the anchors are let go, beginning with the weathermoft anchor, or that which has the cable in the weathermoft haufe hole, and fo on with the next weathermoft anchor, paying out the cables as faft as poffible, that the fhip may keep fhooting a head till all the anchors are let go. And when the neceffity of the fituation requires it, no hefitation fhould be made, immediately to cut away all the mafts, except the foremaft and the bowfprit (the fore topmaft ftay-fail being made to hoift to the fore mafthead) which will not only make the fhip ride with lefs ftrain upon the anchors and cables; but if they give way fhe will be the better prepared, when neceffity requires it to be done, as the laft refuge, to run and lay the fhip on fhore to the beft advantage, in order to fave all the lives and property that is poffible to be faved, rather than let the fhip founder, or ftrike the ground at an anchor by the tide falling, &c. which affords no chance of faving either lives or property.

On Ships being forced on a dangerous Lee Shore.

SITUATIONS, circumftances, times and places are fo different and various, that to give advice on this dreadful occafion is difficult. The beft management on a gradual rifing fhore, in a tidefway, is to ufe all poffible means to keep the fhip from going on fhore till after high water, and the main and mizen-maft being firft cut away, then to run right before the wind and waves with all the canvafs that poffibly can be fet, end on upon the fhore, to make the fhip free herfelf the more, and to run the higher and fafter upon the ground, fo that by the advantage of the tide falling, fhe may foon be fet fo faft as to be out of the power of the waves to hurt her much. By this management, in my opinion, not only all the lives, but the fhip and cargo may be often faved, which would be all loft by letting her go at random with a flowing tide. For it muft be confidered, that a fhip going on fhore in a tidefway upon a flood will continue beating as long as the tide flows and until it falls; and if fhe lies broadfide to the waves, they will have about three times more power on her than when they laid end on to them; and a fhip will bear but little beating on her broadfide, in proportion to what fhe will bear upon her bottom.

Notwithftanding a fhip may be thus fuccefsfully run and fet faft upon a fhore, with little damage to her hull, and no danger to be apprehended till towards high water next tide, if the ftorm continue fo long, yet people too often let their fears overcome their reafon, and, being in too great hurry to quit the fhip, and attempting to get on fhore through the waves, may often lofe their lives; when if they wait till low water they might get on fhore with little or no rifque; and where the rife and fall of the tide is great the fhip may come quite dry at low water: therefore, the people fhould be reftrained from going on fhore with the boats till towards low water; and when got fafe on fhore,

ſhore, it may be abſolutely neceſſary, in order to preſerve the boats, to haul them above high water mark, where they may be turned bottom up, and made a place of ſhelter when there is no other to be had, and be ſtill ready to go to the ſhip, if the weather permits and occaſion requires.

Different ſhores require different management on this dreadful occaſion. And where the ſhore is nothing but hard rocks ſteep to, and under water, and high cliffs above water, which are impoſſible to be climbed up, in this ſituation no ſail can be of any ſervice, therefore all the maſts ſhould be cut away, and ſafety then depends entirely on the ground tackle being uſed to the beſt advantage; and if the ſhip drives till ſhe comes near the high cliffs, it is well known they make both the wind and waves rebound from them to ſome diſtance, where if the ground tackle happen to hold, it may give the ſhip a chance to ride.

On ſaving Lives from a Ship loſt on a Lee Shore.

TO aid and aſſiſt in ſaving the lives of people from ſhips that are forced on a dangerous lee ſhore, muſt be allowed to be one of the greateſt acts of humanity. Time, circumſtances, and ſituations are ſo various, that it is very difficult to write what may be to the purpoſe on this melancholy occaſion. Succeſs in many ſituations may depend greatly on aſſiſtance from people on ſhore; but as that is uncertain and cannot be expected in the night, or in deſert places, or where a current or tide runs ſo ſtrong between the tide and the ſhore as to prevent booms, maſts, yards, &c. with ropes made faſt to them from being veered on ſhore, in this caſe the utmoſt endeavours ſhould be uſed on board, and every method tried to convey the people on ſhore. Let the experiment of a *Flying Storm Kite* be made, that may by the force of the wind carry an iron creeper or grapling made faſt to the end of a rope from the wreck to the ſhore, by which acceſs may be got to the ſhore when prevented by the tide, current, or returning waves. I would propoſe theſe kites to be ſuch as may be eaſily and readily made on board any wrecked veſſel, and to conſiſt only of two ſlips of thin deal board, about three inches broad, the long piece to be 7, 8, or 9 feet long, according to the weight of the creeper, grapling, or boat's anchor, and the rope deſigned to be ſent on ſhore and the croſs piece about half the length of the long piece, to be nailed about a third from the top that forms the kite, to be ſpanned with log or lead line from the four ends of the boards, and covered with a piece of light ſail, and ſlung from the four ends of the boards, and ſtrengthened with a ſpan in the middle to the lower part of the croſs board, where the kite rope is to be ſeized, and at the lower end of the kite a rope 2, 3, or 4 fathoms long is to be bent to the grapling, creeper, or boat's anchor, to anſwer the purpoſe of the kite's tail. Then it may be aſked, how the kite may be made to fall ſo low that the anchor, &c. may take hold of the ground, if neceſſity requires this immediately to be done? Let the kite rope run looſe for a time, and the weight of the anchor, rope, &c. will immediately make it fall upon the ground; and to the kite line a larger rope may be hauled on ſhore by the inhabitants, and fixed ſo that not only lives but property may be ſaved by it.

But in order to get a grapling on ſhore another experiment might be made, viz. to ſhoot it with a rope bent to it laſhed along the outer end of a handſpike, made round juſt to fit the bore of a great gun, and long

enough to reach from the ring of the grapling to the wad next the powder; the gun elevated to its higheft range.

Let it now be fuppofed that a rope is got from the wreck to the fhore, and fecured as well as poffible, till fomebody can be got on fhore by it to fecure it better. Make a bowling knot in the tail of the ftrap of a fingle block; then reeve the fhore rope through the block, and to that part of the wreck where it may lead and be hauled taut to the greateft advantage to fupport the block, travelling upon it from the wreck to the fhore in the fureft and beft manner poffible; and if the wreck have any lower mafts ftanding, the fhore rope leading over the main-maft head would moft likely anfwer the purpofe beft, and the top afford a convenient place to get fixed in, and go from, in the machine to the fhore.

But the facility or difficulty attending the execution of thefe means, are in proportion to the height and diftance of the fhore from the wreck; if the fhore be low and near the wreck, the fhore rope may be made to lead the machine upon it, with an eafy afcent from the wreck to the fhore, with a man or two in it, without much ftrain either to the rope, or grapling on fhore; when this is likely to be the cafe, a line fhould be made faft to the machine to haul it to the wreck again; by which means it may happen that a fhipwrecked crew may foon get on fhore with eafe and fafety.

But when the fhore happens to be at a great diftance and higher than any part of the wreck, this experiment will of courfe be attended with more difficulty. In order, therefore, to eafe the ftrain on the fhore rope and grapling, fix a fmall fail to the machine, fuch as a hammock or two, &c. this, fet as a fail upon the machine that is to run right before the wind in a ftorm, will certainly help greatly to lift and leffen the ftrain of the machine on the fhore rope, and force it forward with great power towards the fhore. A man or two got on fhore by thefe means may greatly contribute, by making things fecure on fhore, to the faving the whole crew, before the fhip goes to pieces.

But fuppofing the fhip to be wrecked where there is neither tide nor current to prevent any thing that will float being drove on fhore by the waves; in this cafe a towline, or any fuitable rope with a hauling line, may be made faft about the middle of a fpar, and veered away on fhore as far as it will go; and if it happens to be an uneven rocky fhore, it may chance to fix itfelf faft amongft the rocks. But if it be a fandy or gravelly fhore, then no fuch chance can be expected; it will then require fome people on fhore to haul it up, and put it under the fand or gravel, with its broadfide to the wreck, to make it bear the ftrain that is neceffary for the rope to be tight enough for the machine to travel upon from the wreck to the fhore.

Before concluding this article we fhall give a defcription of the MARINE SPENCER, prefented to the Royal Humane Society of London by Mr. KNIGHT SPENCER, and communicated to me, together with the Refufcitative Procefs, by Dr. Hawes, Treafurer to the above Society, conceiving they may be of infinite ufe in many inftances.

The Marine Spencer is a girdle of a diameter to fit the body, fix inches broad, compofed of about 800 old tavern corks ftrung upon a ftrong twine, well lafhed together, covered with canvafs and painted in oil, fo as to make it water-proof. Two tapes or cords, about two feet long, muft be faftened to the back of the girdle, with loops at the ends.

Another

Another tape or cord, about three feet long, in the middle of which a few corks are ſtrung covered with canvaſs, and painted as above, muſt alſo be faſtened to the back of the girdle. Two pins of hard wood, three inches long and half an inch diameter, muſt be faſtened to the front of the girdle, one to the upper, the other to the lower part. When the Marine Spencer is to be uſed, ſlide it from the feet cloſe up under the arms; bring the two tapes or cords one over each ſhoulder, and faſten them by the loops to the pin on the upper part of the front of the girdle; bring the other tape or cord between the legs, and faſten it to the other pin.

A perſon thus equipped, though unacquainted with ſwimming, may ſafely truſt himſelf to the waves; for he will float head and ſhoulders above the water in any ſtorm, and by paddling with his hands may eaſily gain the ſhore.

A Marine Spencer conſtructed as above, and covered with ſtrong canvaſs unpainted, will have nearly the ſame buoyancy, though more liable to damage from the effects of ſea water.*

We further add the Reſuſcitative Proceſs, wiſhing to contribute all in our power to the benefit of our ſeafaring brethren.

* There is now in vogue a Leather Girdle, which, when filled with air, they have given the name of Life Preſerver.

Directions for the Reſtoration of the Drowned, thoſe ſuſpended by the Cord, intenſe Cold, or tremendous Lightning.

1. CONVEY carefully the body, with the head raiſed, and ſend to the neareſt medical aſſiſtant.

2. Strip, dry the body, clean the mouth and noſtrils.

3. Young children to be put between two perſons in a warm bed.

4. An adult—Lay the unfortunate perſon on a bed, and in cold weather near the fire. In ſummer expoſe the body to the rays of the ſun, and air ſhould be freely admitted.

5. The body to be gently rubbed with flannel ſprinkled with ſpirits, flour of muſtard, &c. ſalt never to be employed; alſo a *heated warming pan*, properly covered, may be lightly moved over the back and ſpine.

6. *To reſtore Breathing.*—Introduce the pipe of a bellows (when no apparatus is at hand) into *one* noſtril; *the other* and the mouth being cloſed, *inflate the lungs*, till the breaſt be a little raiſed; the mouth and noſtrils muſt then be let free. This proceſs to be repeated till the return of life.

7. The breaſt to be fomented with hot ſpirits; warm bricks or tiles covered, &c. to be applied to the ſoles of the feet and palms of the hands.

8. Tobacco ſmoke is to be thrown gently into the fundament with a proper inſtrument, or the bowl of a pipe covered, ſo as to defend the mouth of the aſſiſtant.

9. Electricity to be early employed, either by the medical aſſiſtants, or other judicious practitioners.

It is much to be lamented that the moſt approved methods of aſſiſting ſhips in diſtreſs are not recommended or deſcribed in prints, for the

purpoſe

purpose of being distributed amongst our ships, and amongst the inhabitants along our sea coast; and rewards should be held out to the poor people along shore for every human life saved by them from vessels in distress; which reward might also be the means of saving their own lives from the just laws of their country, by preventing them from plundering, and might encourage them to join heartily in whatever method they perceive people on board the wreck take to preserve themselves, and to help them in it, by securing the shore rope, or using the hauling line to haul the machine on shore, if it is high above the wreck, &c. The difficulty we now meet with in manning both ships of war and merchant ships, should teach us to use every possible method to preserve the lives of our brave seamen, those supporters of our glory, power, wealth, and consequence as a nation. How pleasing must the reflection be to all who contribute to help them!

Remarks calculated to assist Commanders when coming into the British Channel.

AS Mariners know that their reckonings are always uncertain, in proportion to the length of their several passages from the times of their last departure, it is natural to suppose that they must, when approaching to any difficult and dangerous navigation, experience great anxiety of mind for the issue. As the British Channel has proved fatal to many, it may fairly be ranked among those places which are deemed dangerous to ships, in their approach after long passages; and, therefore, all those who are entrusted with the conducting of ships through it, ought to acquire such knowledge as may enable them to perform the duties of their important office. Channel-coasters, by the frequency of their passing and repassing through it, acquire such knowledge as those who are employed in foreign voyages cannot pretend to: hence it becomes necessary to furnish the latter with some useful information; more especially, as it is next to impossible for the human mind, when engaged in various pursuits, to remember every necessary article, such as the course and distance from one place to another; the precise situation of rocks and shoals; and the direction and strength of the tide in the various places. Commanders of ships, when coming from abroad, and about to enter the British Channel, must be exceedingly anxious to accomplish the ultimate design of their voyage, by bringing their respective ships safely into port. To the assistance of such, the following observations are intended to contribute: they are founded on experience, and will, if properly observed, prove highly serviceable, especially when long nights, or thick weather, augment those dangers which attend the Channel navigation.

Ships, in approaching the Channel from a long passage, should not only try for soundings in time, but run, if possible, in the latitude of 49° 25′ North. Having, in that parallel, got soundings in 82 fathoms, fine white sand, with black and yellow specks, you may be sure that you are near the outer edge of the bank; and about 50 leagues to the westward of Scilly. By running 16 or 17 leagues further to the eastward, in the same parallel of latitude, you will have 90 fathoms, fine white sand; and continuing to run four leagues more to the eastward, you will shoal your water to 82 fathoms. Soon afterwards, you will have 72 and 75 fathoms, fine white sand, with sometimes a mixture of

of green; and in proceeding 16 or 17 leagues further to the eastward in this latitude, you will have 72, 75, 77, and 80 fathoms. The soundings will be, for the most part, fine sand, but different in colour; some of them will be white sand, mixed with yellow specks; and others fine green sand, with some mud. In the latitude of 48° 23′ North, and 61 leagues to the westward of Ushant, lies the Nymph Bank. It stretches about S. S. E. and N. N. W. 12 leagues in length and four in breadth; and has 64 fathoms on it, fine grey sand.

The following are the Soundings in the Parallels of 48° 20′, and and 48° 30′, with their several depths of Water and Distances from the Island of USHANT.

Dist. from Ushant. Leagues.	QUALITY OF THE SOUNDINGS.	Depth in Fathoms. Fren. Ft.	Eng. Ft.
52 —	Fine grey sand, mixed with black	— 62	83
49 —	Fine grey sand, mixed with small shells and broken bits	— 106	96
46 —	Grey sand, mixed with bits of brown shells	— 110	99
43 —	Grey sand, mixed with bits of shells and brown sand	— 108	97
40 —	Grey sand, mixed with bits of shells and gravel	— 117	106
37 —	Grey sand, mixed with shells and gravel	— 104	94
35 —	Grey sand, mixed with small cornet shells	— 110	99
32 —	Sand, mixed with gravel, shells, and small cornets	— 108	97
29 —	Whitish grey sand and flat stones	— 108	97
24 —	Light grey sand, with bits of shells	— 100	90
21 —	Coarse sand, with bits of cockle shells	— 98	88
18 —	Light grey sand, with bits of brown and yellow shells, and small stones	— 90	81
15 —	Light grey sand, mixed with barley-beards	— 84	76
14 —	Whitish grey sand, bits of shells and fine cornets	— 80	72
11 —	Light grey sand, mixed with barley-beards and small shells	— 79	71
9 —	Fine grey sand, with bits of shells	— 75	68
8 —	Grey sand, spotted with red, and mixed with bits of shells	— 75	68
6 —	Whitish coarse shining sand, with fine shells	— 70	63
4 —	Whitish coarse shining sand, mixed with barley beards and coral	— 65	59
2 —	Whitish coarse sand	— 64	58

When running for the channel in latitude 49° 25′, which is the best latitude, and you have run so far to the eastward as to shoalen your water to 65 or 67 fathoms, and the soundings are shells and small yellow stones or red sand, you may thence conclude that you are abreast of Scilly; or if you have 68 fathoms, white sand with grey specks, and sometimes shells and stones, Scilly will then bear about N. E. from you, distance 10 leagues. Your soundings will always inform you whether you are to the northward or southward of Scilly. In the latitude of Scilly you will have oazy ground, in 60, 65, 75, or 80 fathoms. W. N. W. 10 leagues from Scilly, lies

lies Jones's Bank, on which you will have but 30, 35, and 40 fathoms; and, a little to the southward of it, you will have 72 and 75 fathoms. In running for the channel, in the latitude of 49° 30′, you will have the following depths of water and soundings, when you are abreast Scilly; namely, 60 fathoms, oaze and broken shells; 64 fathoms, white sand with grey specks; 65 fathoms, shells and stones; and 55 fathoms, fine grey sand. The soundings near Scilly are very different from all others in this latitude: pieces of rotten rock, as broad as a small bean, and of a stone colour, will come up with the lead, which will not be the case any where else in the same parallel. More to the southward you will have deeper water, with fine sand, interspersed with black specks like ground pepper. In the night, or in foggy weather, you should come no nearer to Scilly than 60 fathoms; for, in that depth, you will not be more than six or seven leagues from it. Abreast of Scilly, in the latitude of 49° 20′, you will have 70 fathoms, branny, or yellow and white sand; and, to the eastward of Scilly, in the latitude of 49° 8′, you will have 56 or 58 fathoms, coarse sand. You should then steer more to the northward, and endeavour to make the land about the Lizard; you may safely make it in the night, as well as in the day, if the weather be clear; for the light-houses stand so high, and the coast is so clear, that you may, without danger, come within half a mile of the point. If the weather prove so thick that you cannot safely make the land, come no nearer to the Lizard than 45 fathoms; for, in that depth, you will not be more than three leagues off the point: your soundings there will be pebble stones and scallop shells.

Ships, when coming into the Channel, ought always, if possible, to make the land about the Lizard; and should they afterwards meet with thick weather, they will not only know how to steer, but also how they advance up the Channel, which will become more and more necessary in proportion to the contraction of its boundaries. Some have, contrary to their expectations, got on the south side of the Channel. This error is greatly owing to the strong indraught between the islands of Guernsey and Jersey, and the coast of Brittany, which ought always to be guarded against, especially in thick weather. It frequently happens that ships, coming into the Channel, have not had an observation for some days back, which, together with the operation of scant and contrary winds, and the setting of the tides, tend to perplex and bewilder the most experienced mariner, when thick weather prevents him from getting a sight of the land. The variation of the compass in the entrance of the Channel, is nearly 29° W.; but as the variation is continually increasing at the rate of about a degree in every five years and a half, it will be necessary to add eleven minutes for every year, subsequent to the year 1806, which will give you the true variation at any time pretty exact.

TABLE

Dist	Lat.	Dep	Dist	Lat.	Dep	Dist	Lat.	Dep	Dist	Lat.	Dep	Dist	Lat.	Dep
1	01.0	00.0	61	60.9	03.0	121	120.9	05.9	181	180.8	08.9	241	240.7	11.8
2	02.0	00.1	62	61.9	03.0	22	121.9	06.0	82	181.8	08.9	42	241.7	11.9
3	03.0	00.1	63	62.9	03.1	23	122.9	06.0	83	182.8	09.0	43	242.7	11.9
4	04.0	00.2	64	63.9	03.1	24	123.9	06.1	84	183.8	09.0	44	243.7	12.0
5	05.0	00.2	65	64.9	03.2	25	124.8	06.1	85	184.8	09.1	45	244.7	12.0
6	06.0	00.3	66	65.9	03.2	26	125.8	06.2	86	185.8	09.1	46	245.7	12.1
7	07.0	00.3	67	66.9	03.3	27	126.8	06.2	87	186.8	09.2	47	246.7	12.1
8	08.0	00.4	68	67.9	03.3	28	127.8	06.3	88	187.8	09.2	48	247.7	12.2
9	09.0	00.4	69	68.9	03.4	29	128.8	06.3	89	188.8	09.3	49	248.7	12.2
10	10.0	00.5	70	69.9	03.4	30	129.8	06.4	90	189.8	09.3	50	249.7	12.3
11	11.0	00.5	71	70.9	03.5	131	130.8	06.4	191	190.8	09.4	251	250.7	12.3
12	12.0	00.6	72	71.9	03.5	32	131.8	06.5	92	191.8	09.4	52	251.7	12.4
13	13.0	00.6	73	72.9	03.6	33	132.8	06.5	93	192.8	09.5	53	252.7	12.4
14	14.0	00.7	74	73.9	03.6	34	133.8	06.6	94	193.8	09.5	54	253.7	12.5
15	15.0	00.7	75	74.9	03.7	35	134.8	06.6	95	194.8	09.6	55	254.7	12.5
16	16.0	00.8	76	75.9	03.7	36	135.8	06.7	96	195.8	09.6	56	255.7	12.6
17	17.0	00.8	77	76.9	03.8	37	136.8	06.7	97	196.8	09.7	57	256.7	12.6
18	18.0	00.9	78	77.9	03.8	38	137.8	06.8	98	197.8	09.7	58	257.7	12.7
19	19.0	00.9	79	78.9	03.9	39	138.8	06.8	99	198.8	09.8	59	258.7	12.7
20	20.0	01.0	80	79.9	03.9	40	139.8	06.9	200	199.8	09.8	60	259.7	12.8
21	21.0	01.0	81	80.9	04.0	141	140.8	06.9	201	200.8	09.9	261	260.7	12.8
22	22.0	01.1	82	81.9	04.0	42	141.8	07.0	02	201.8	09.9	62	261.7	12.9
23	23.0	01.1	83	82.9	04.1	43	142.8	07.0	03	202.8	10.0	63	262.7	12.9
24	24.0	01.2	84	83.9	04.1	44	143.8	07.1	04	203.8	10.0	64	263.7	13.0
25	25.0	01.2	85	84.9	04.2	45	144.8	07.1	05	204.8	10.1	65	264.7	13.0
26	26.0	01.3	86	85.9	04.2	46	145.8	07.2	06	205.8	10.1	66	265.7	13.1
27	27.0	01.3	87	86.9	04.3	47	146.8	07.2	07	206.8	10.2	67	266.7	13.1
28	28.0	01.4	88	87.9	04.3	48	147.8	07.3	08	207.7	10.2	68	267.7	13.2
29	29.0	01.4	89	88.9	04.4	49	148.8	07.3	09	208.7	10.3	69	268.7	13.2
30	30.0	01.5	90	89.9	04.4	50	149.8	07.4	10	209.7	10.3	70	269.7	13.2
31	31.0	01.5	91	90.9	04.5	151	150.8	07.4	211	210.7	10.4	271	270.7	13.3
32	32.0	01.6	92	91.9	04.5	52	151.8	07.5	12	211.7	10.4	72	271.7	13.3
33	33.0	01.6	93	92.9	04.6	53	152.8	07.5	13	212.7	10.5	73	272.7	13.4
34	34.0	01.7	94	93.9	04.6	54	153.8	07.6	14	213.7	10.5	74	273.7	13.4
35	35.0	01.7	95	94.9	04.7	55	154.8	07.6	15	214.7	10.5	75	274.7	13.5
36	36.0	01.8	96	95.9	04.7	56	155.8	07.7	16	215.7	10.6	76	275.7	13.5
37	37.0	01.8	97	96.9	04.8	57	156.8	07.7	17	216.7	10.6	77	276.7	13.6
38	38.0	01.9	98	97.9	04.8	58	157.8	07.8	18	217.7	10.7	78	277.7	13.6
39	39.0	01.9	99	98.9	04.9	59	158.8	07.8	19	218.7	10.7	79	278.7	13.7
40	40.0	02.0	100	99.9	04.9	60	159.8	07.9	20	219.7	10.8	80	279.7	13.7
41	41.0	02.0	101	100.9	05.0	161	160.8	07.9	221	220.7	10.8	281	280.7	13.8
42	41.9	02.1	02	101.9	05.0	62	161.8	08.0	22	221.7	10.9	82	281.7	13.8
43	42.9	02.1	03	102.9	05.1	63	162.8	08.0	23	222.7	10.9	83	282.7	13.9
44	43.9	02.2	04	103.9	05.1	64	163.8	08.1	24	223.7	11.0	84	283.7	13.9
45	44.9	02.2	05	104.9	05.2	65	164.8	08.1	25	224.7	11.0	85	284.7	14.0
46	45.9	02.3	06	105.9	05.2	66	165.8	08.1	26	225.7	11.1	86	285.7	14.0
47	46.9	02.3	07	106.9	05.3	67	166.8	08.2	27	226.7	11.1	87	286.7	14.1
48	47.9	02.4	08	107.9	05.3	68	167.8	08.2	28	227.7	11.2	88	287.7	14.1
49	48.9	02.4	09	108.9	05.4	69	168.8	08.3	29	228.7	11.2	89	288.7	14.2
50	49.9	02.5	10	109.9	05.4	70	169.8	08.3	30	229.7	11.3	90	289.7	14.2
51	50.9	02.5	111	110.9	05.4	171	170.8	08.4	231	230.7	11.3	291	290.7	14.3
52	51.9	02.6	12	111.9	05.5	72	171.8	08.4	32	231.7	11.4	92	291.6	14.3
53	52.9	02.6	13	112.9	05.5	73	172.8	08.5	33	232.7	11.4	93	292.6	14.4
54	53.9	02.7	14	113.9	05.6	74	173.8	08.5	34	233.7	11.5	94	293.6	14.4
55	54.9	02.7	15	114.9	05.6	75	174.8	08.6	35	234.7	11.5	95	294.6	14.5
56	55.9	02.7	16	115.9	05.7	76	175.8	08.6	36	235.7	11.6	96	295.6	14.5
57	56.9	02.8	17	116.9	05.7	77	176.8	08.7	37	236.7	11.6	97	296.6	14.6
58	57.9	02.8	18	117.9	05.8	78	177.8	08.7	38	237.7	11.7	98	297.6	14.6
59	58.9	02.9	19	118.9	05.8	79	178.8	08.8	39	238.7	11.7	99	298.6	14.7
60	59.9	02.9	20	119.9	05.9	80	179.8	08.8	40	239.7	11.8	300	299.6	14.7
Dist	Dep	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 7 ¾ Points.

TABLE I. Difference of Latitude and Departure for 1 Point.

Dist	Lat.	Dep	Dist	Lat.	Dep	Dist	Lat.	Dep	Dist	Lat.	Dep	Dist	Lat.	Dep
1	01.0	00.2	61	59.8	11.9	121	118.7	23.6	181	177.5	35.3	241	236.4	47.0
2	02.0	00.4	62	60.8	12.1	22	119.6	23.8	82	178.5	35.5	42	237.4	47.2
3	02.9	00.6	63	61.8	12.3	23	120.6	24.0	83	179.5	35.7	43	238.3	47.4
4	03.9	00.8	64	62.8	12.5	24	121.6	24.2	84	180.5	35.9	44	239.3	47.6
5	04.9	01.0	65	63.8	11.7	25	122.6	24.4	85	181.4	36.1	45	240.3	47.8
6	05.9	01.2	66	64.7	12.9	26	123.6	24.6	86	182.4	36.3	46	241.3	48.0
7	06.9	01.4	67	65.7	13.1	27	124.6	24.8	87	183.4	36.5	47	242.3	48.2
8	07.8	01.6	68	66.7	13.3	28	125.5	25.0	88	184.4	36.7	48	243.2	48.4
9	08.8	01.8	69	67.7	13.5	29	126.5	25.2	89	185.4	36.9	49	244.2	48.6
10	09.8	02.0	70	68.7	13.7	30	127.5	25.4	90	186.3	37.1	50	245.2	48.8
11	10.8	02.1	71	69.6	13.9	131	128.5	25.6	191	187.3	37.3	251	246.2	49.0
12	11.8	02.3	72	70.6	14.0	32	129.5	25.8	92	188.3	37.5	52	247.2	49.2
13	12.8	02.5	73	71.6	14.2	33	130.4	25.9	93	189.3	37.7	53	248.1	49.4
14	13.7	02.7	74	72.6	14.4	34	131.4	26.1	94	190.3	37.8	54	249.1	49.6
15	14.7	02.9	75	73.6	14.6	35	132.4	26.3	95	191.3	38.0	55	250.1	49.7
16	15.7	03.1	76	74.5	14.8	36	133.4	26.5	96	192.2	38.2	56	251.1	49.9
17	16.7	03.3	77	75.5	15.0	37	134.4	26.7	97	193.2	38.4	57	252.1	50.1
18	17.7	03.5	78	76.5	15.2	38	135.3	26.9	98	194.2	38.6	58	253.0	50.3
19	18.6	03.7	79	77.5	15.4	39	136.3	27.1	99	195.2	38.8	59	254.0	50.5
20	19.6	03.9	80	78.5	15.6	40	137.3	27.3	200	196.2	39.0	60	255.0	50.7
21	20.6	04.1	81	79.4	15.8	141	138.3	27.5	201	197.1	39.2	261	256.0	50.9
22	21.6	04.3	82	80.4	16.0	42	139.3	27.7	02	198.1	39.4	62	257.0	51.1
23	22.6	04.5	83	81.4	16.2	43	140.3	27.9	03	199.1	39.6	63	257.9	51.3
24	23.5	04.7	84	82.4	16.4	44	141.2	28.1	04	200.1	39.8	64	258.9	51.5
25	24.5	04.9	85	83.4	16.6	45	142.2	28.3	05	201.1	40.0	65	259.9	51.7
26	25.5	05.1	86	84.3	16.8	46	143.2	28.5	06	202.0	40.2	66	260.9	51.9
27	26.5	05.3	87	85.3	17.0	47	144.2	28.7	07	203.0	40.4	67	261.9	52.1
28	27.5	05.5	88	86.3	17.2	48	145.2	28.9	08	204.0	40.6	68	262.9	52.3
29	28.4	05.7	89	87.3	17.4	49	146.1	29.1	09	205.0	40.8	69	263.8	52.5
30	29.4	05.9	90	88.3	17.6	50	147.1	29.3	10	206.0	41.0	70	264.8	52.7
31	30.4	06.0	91	89.3	17.8	151	148.1	29.5	211	206.9	41.2	271	265.8	52.9
32	31.4	06.2	92	90.2	17.9	52	149.1	29.7	12	207.9	41.4	72	266.8	53.1
33	32.4	06.4	93	91.2	18.1	53	150.1	29.9	13	208.9	41.6	73	267.8	53.3
34	33.3	06.6	94	92.2	18.3	54	151.0	30.0	14	209.9	41.7	74	268.7	53.5
35	34.3	06.8	95	93.2	18.5	55	152.0	30.2	15	210.9	41.9	75	269.7	53.6
36	35.3	07.0	96	94.2	18.7	56	153.0	30.4	16	211.8	42.1	76	270.7	53.8
37	36.3	07.2	97	95.1	18.9	57	154.0	30.6	17	212.8	42.3	77	271.7	54.0
38	37.3	07.4	98	96.1	19.1	58	155.0	30.8	18	213.8	42.5	78	272.7	54.2
39	38.3	07.6	99	97.1	19.3	59	155.9	31.0	19	214.8	42.7	79	273.6	54.4
40	39.2	07.8	100	98.1	19.5	60	156.9	31.2	20	215.8	42.9	80	274.6	54.6
41	40.2	08.0	101	99.1	19.7	161	157.9	31.4	221	216.8	43.1	281	275.6	54.8
42	41.2	08.2	02	100.0	19.9	62	158.9	31.6	22	217.7	43.3	82	276.6	55.0
43	42.2	08.4	03	101.0	20.1	63	159.9	31.8	23	218.7	43.5	83	277.6	55.2
44	43.2	08.6	04	102.0	20.3	64	160.8	32.0	24	219.7	43.7	84	278.5	55.4
45	44.1	08.8	05	103.0	20.5	65	161.8	32.2	25	220.7	43.9	85	279.5	55.6
46	45.1	09.0	06	104.0	20.7	66	162.8	32.4	26	221.7	44.1	86	280.5	55.8
47	46.1	09.2	07	104.9	20.9	67	163.8	32.6	27	222.6	44.3	87	281.5	56.0
48	47.1	09.4	08	105.9	21.1	68	164.8	32.8	28	223.6	44.5	88	282.5	56.2
49	48.1	09.6	09	106.9	21.3	69	165.8	33.0	29	224.6	44.7	89	283.4	56.4
50	49.0	09.8	10	107.9	21.5	70	166.7	33.2	30	225.6	44.9	90	284.4	56.6
51	50.0	09.9	111	108.9	21.7	171	167.7	33.4	231	226.6	45.1	291	285.4	56.8
52	51.0	10.1	12	109.8	21.9	72	168.7	33.6	32	227.5	45.3	92	286.4	57.0
53	52.0	10.3	13	110.8	22.0	73	169.7	33.8	33	228.5	45.5	93	287.4	57.2
54	53.0	10.5	14	111.8	22.2	74	170.7	33.9	34	229.5	45.7	94	288.4	57.4
55	53.9	10.7	15	112.8	22.4	75	171.6	34.1	35	230.5	45.8	95	289.3	57.6
56	54.9	10.9	16	113.8	22.6	76	172.6	34.3	36	231.5	46.0	96	290.3	57.7
57	55.9	11.1	17	114.8	22.8	77	173.6	34.5	37	232.4	46.2	97	291.3	57.9
58	56.9	11.3	18	115.7	23.0	78	174.6	34.7	38	233.4	46.4	98	292.3	58.1
59	57.9	11.5	19	116.7	23.2	79	175.6	34.9	39	234.4	46.6	99	293.3	58.3
60	58.8	11.7	20	117.7	23.4	80	176.5	35.1	40	235.4	46.8	300	294.2	58.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 7 Points

Table I. Difference of Latitude and Departure for ¾ Point.

Dist	Lat.	Dep	Dist	Lat.	Dep	Dist	Lat.	Dep	Dist	Lat.	Dep	Dist	Lat.	Dep
1	01.0	00.1	61	60.3	09.0	121	119.7	17.8	181	179.0	26.5	241	238.4	35.4
2	02.0	00.3	62	61.3	09.1	22	120.7	17.8	82	180.0	26.7	42	239.4	35.5
3	03.0	00.4	63	62.3	09.2	23	121.7	18.0	83	181.0	26.8	43	240.4	35.7
4	04.0	00.6	64	63.3	09.4	24	122.7	18.2	84	182.0	27.0	44	241.3	35.8
5	04.9	00.7	65	64.3	09.5	25	123.6	18.3	85	183.0	27.1	45	242.3	35.9
6	05.9	00.9	66	65.3	09.7	26	124.6	18.5	86	184.0	27.3	46	243.3	35.1
7	06.9	01.0	67	66.3	09.8	27	125.6	18.6	87	185.0	27.4	47	244.3	36.2
8	07.9	01.2	68	67.3	10.0	28	126.6	18.8	88	186.0	27.6	48	245.3	36.4
9	08.9	01.3	69	68.3	10.1	29	127.6	18.9	89	187.0	27.7	49	246.3	36.5
10	09.9	01.5	70	69.2	10.3	30	128.6	19.1	90	187.9	27.9	50	247.3	36.7
11	10.9	01.6	71	70.2	10.4	131	129.6	19.2	191	188.9	28.0	251	248.3	36.8
12	11.9	01.8	72	71.2	10.6	32	130.6	19.4	92	189.9	28.2	52	249.3	37.0
13	12.9	01.9	73	72.2	10.7	33	131.6	19.5	93	190.9	28.3	53	250.3	37.1
14	13.8	02.1	74	73.2	10.9	34	132.5	19.7	94	191.9	28.5	54	251.3	37.3
15	14.8	02.2	75	74.2	11.0	35	133.5	19.8	95	192.9	28.6	55	252.2	37.4
16	15.8	02.3	76	75.2	11.2	36	134.5	20.0	96	193.9	28.7	56	253.2	37.6
17	16.8	02.5	77	76.2	11.3	37	135.5	20.1	97	194.9	28.9	57	254.2	37.7
18	17.8	02.6	78	77.2	11.4	38	136.5	20.2	98	195.9	29.0	58	255.2	37.9
19	18.8	02.8	79	78.1	11.6	39	137.5	20.4	99	196.8	29.2	59	256.2	38.0
20	19.8	02.9	80	79.1	11.7	40	138.5	20.5	200	197.8	29.3	60	257.2	38.1
21	20.8	03.1	81	80.1	11.9	141	139.5	20.7	201	198.8	29.5	261	258.2	38.3
22	21.8	03.2	82	81.1	12.0	42	140.5	20.8	02	199.8	29.6	62	259.2	38.4
23	22.8	03.4	83	82.1	12.2	43	141.5	21.0	03	200.8	29.8	63	260.2	38.6
24	23.7	03.5	84	83.1	12.3	44	142.4	21.1	04	201.8	29.9	64	261.1	38.7
25	24.7	03.7	85	84.1	12.5	45	143.4	21.3	05	202.8	30.1	65	262.1	38.9
26	25.7	03.8	86	85.1	12.6	46	144.4	21.4	06	203.8	30.2	66	263.1	39.0
27	26.7	04.0	87	86.1	12.8	47	145.4	21.6	07	204.8	30.4	67	264.1	39.2
28	27.7	04.1	88	87.0	12.9	48	146.4	21.7	08	205.7	30.5	68	265.1	39.3
29	28.7	04.3	89	88.0	13.0	49	147.4	21.9	09	206.7	30.7	69	266.1	39.5
30	29.7	04.4	90	89.0	13.2	50	148.4	22.0	10	207.7	30.8	70	267.1	39.6
31	30.7	04.5	91	90.0	13.4	151	149.4	22.2	211	208.7	31.0	271	268.1	39.8
32	31.7	04.7	92	91.0	13.5	52	150.4	22.3	12	209.7	31.1	72	269.1	39.9
33	32.6	04.8	93	92.0	13.6	53	151.3	22.4	13	210.7	31.2	73	270.0	40.1
34	33.6	05.0	94	93.0	13.8	54	152.3	22.6	14	211.7	31.4	74	271.0	40.2
35	34.6	05.1	95	94.0	13.9	55	153.3	22.7	15	212.7	31.5	75	272.0	40.4
36	35.6	05.3	96	95.0	14.1	56	154.3	22.9	16	213.7	31.7	76	273.0	40.5
37	36.6	05.4	97	95.9	14.2	57	155.3	23.0	17	214.7	31.8	77	274.0	40.6
38	37.6	05.6	98	96.9	14.4	58	156.3	23.2	18	215.6	32.0	78	275.0	40.8
39	38.6	05.7	99	97.9	14.5	59	157.3	23.3	19	216.6	32.1	79	276.0	40.9
40	39.6	05.9	100	98.9	14.7	60	158.3	23.5	20	217.6	32.3	80	277.0	41.1
41	40.6	06.0	101	99.9	14.8	161	159.3	23.6	221	218.6	32.4	281	278.0	41.2
42	41.5	06.2	02	100.9	15.0	62	160.2	23.8	22	219.6	32.6	82	278.9	41.4
43	42.5	06.3	03	101.9	15.1	63	161.2	23.9	23	220.6	32.7	83	279.9	41.6
44	43.5	06.5	04	102.9	15.3	64	162.2	24.1	24	221.6	32.9	84	280.9	41.7
45	44.5	06.6	05	103.9	15.4	65	163.2	24.2	25	222.6	33.0	85	281.9	41.8
46	45.5	06.7	06	104.9	15.6	66	164.2	24.4	26	223.6	33.2	86	282.9	42.0
47	46.5	06.9	07	105.8	15.7	67	165.2	24.5	27	224.5	33.3	87	283.9	42.1
48	47.5	07.0	08	106.8	15.8	68	166.2	24.7	28	225.5	33.5	88	284.9	42.3
49	48.5	07.2	09	107.8	16.0	69	167.2	24.8	29	226.5	33.6	89	285.9	42.4
50	49.5	07.3	10	108.8	16.1	70	168.2	24.9	30	227.5	33.7	90	286.9	42.6
51	50.4	07.5	111	109.8	16.3	171	169.1	25.1	231	228.5	33.9	291	287.9	42.7
52	51.4	07.6	12	110.8	16.4	72	170.1	25.2	32	229.5	34.0	92	288.8	42.8
53	52.4	07.8	13	111.8	16.6	73	171.1	25.4	33	230.5	34.2	93	289.8	43.0
54	53.4	07.9	14	112.8	16.7	74	172.1	25.5	34	231.5	34.3	94	290.8	43.1
55	54.4	08.1	15	113.8	16.9	75	173.1	25.7	35	232.5	34.5	95	291.8	43.3
56	55.4	08.2	16	114.7	17.0	76	174.1	25.8	36	233.4	34.6	96	292.8	43.4
57	56.4	08.4	17	115.7	17.2	77	175.1	26.0	37	234.4	34.8	97	293.8	43.6
58	57.4	08.5	18	116.7	17.3	78	176.1	26.1	38	235.4	34.9	98	294.8	43.7
59	58.4	08.7	19	117.7	17.5	79	177.1	26.3	39	236.4	35.1	99	295.8	43.9
60	59.3	08.8	20	118.7	17.6	80	178.1	26.4	40	237.4	35.2	300	296.8	44.0
Dist	Dep	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 7 ¼ Points.

TABLE I. Difference of Latitude and Departure for 1 ½ Points.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.3	61	58.4	17.7	121	115.8	35.1	181	173.2	52.5	241	230.6	70.0
2	01.9	00.6	62	59.3	18.0	22	116.7	35.4	82	174.2	52.8	42	231.6	70.2
3	02.9	00.9	63	60.3	18.3	23	117.7	35.7	83	175.1	53.1	43	232.5	70.5
4	03.8	01.2	64	61.2	18.6	24	118.7	36.0	84	176.1	53.4	44	233.5	70.8
5	04.8	01.5	65	62.2	18.9	25	119.6	36.3	85	177.0	53.7	45	234.5	71.1
6	05.7	01.7	66	63.2	19.2	26	120.6	36.6	86	178.0	54.0	46	235.4	71.4
7	06.7	02.0	67	64.1	19.4	27	121.5	36.9	87	179.0	54.3	47	236.4	71.7
8	07.7	02.3	68	65.1	19.7	28	122.5	37.2	88	179.9	54.6	48	237.3	72.0
9	08.6	02.6	69	66.0	20.0	29	123.4	37.4	89	180.9	54.9	49	238.3	72.3
10	09.6	02.9	70	67.0	20.3	30	124.4	37.7	90	181.8	55.0	50	239.2	72.6
11	10.5	03.2	71	67.9	20.6	131	125.4	38.0	191	182.8	55.4	251	240.2	72.9
12	11.5	03.5	72	68.9	20.9	32	126.3	38.3	92	183.7	55.7	52	241.1	73.2
13	12.4	03.8	73	69.9	21.2	33	127.3	38.6	93	184.7	56.0	53	242.1	73.4
14	13.4	04.1	74	70.8	21.5	34	128.2	38.9	94	185.6	56.3	54	243.1	73.7
15	14.4	04.4	75	71.8	21.8	35	129.2	39.2	95	186.6	56.6	55	244.0	74.0
16	15.3	04.6	76	72.7	22.1	36	130.1	39.5	96	187.6	56.9	56	245.0	74.3
17	16.3	04.9	77	73.7	22.4	37	131.1	39.8	97	188.5	57.2	57	245.9	74.6
18	17.2	05.2	78	74.6	22.6	38	132.1	40.0	98	189.5	57.5	58	246.9	74.9
19	18.2	05.5	79	75.6	22.9	39	133.0	40.3	99	190.4	57.8	59	247.8	75.2
20	19.1	05.8	80	76.6	23.2	40	134.0	40.6	200	191.4	58.1	60	248.8	75.5
21	20.1	06.1	81	77.5	23.5	141	134.9	40.9	201	192.3	58.3	261	249.8	75.8
22	21.1	06.4	82	78.5	23.8	42	135.9	41.2	02	193.3	58.6	62	250.7	76.1
23	22.0	06.7	83	79.4	24.1	43	136.8	41.5	03	194.3	58.9	63	251.7	76.3
24	23.0	07.0	84	80.4	24.4	44	137.8	41.8	04	195.2	59.2	64	252.6	76.6
25	23.9	07.3	85	81.3	24.7	45	138.8	42.1	05	196.2	59.5	65	253.6	76.9
26	24.9	07.5	86	82.3	25.0	46	139.7	42.4	06	197.1	59.8	66	234.5	77.2
27	25.9	07.8	87	83.3	25.2	47	140.7	42.7	07	198.1	60.1	67	255.5	77.5
28	26.8	08.1	88	84.2	25.5	48	141.6	43.0	08	199.0	60.4	68	256.5	77.8
29	27.8	08.4	89	85.2	25.8	49	142.6	43.3	09	200.0	60.7	69	257.4	78.1
30	28.7	08.7	90	86.1	26.1	50	143.5	43.5	10	201.0	61.0	70	258.4	78.4
31	29.7	09.0	91	87.1	26.4	151	144.5	43.8	211	201.9	61.2	271	259.3	78.7
32	30.6	09.3	92	88.0	26.7	52	145.5	44.1	12	202.9	61.5	72	260.3	78.9
33	31.6	09.6	93	89.0	27.0	53	146.4	44.4	13	203.8	61.8	73	261.2	79.2
34	32.5	09.9	94	90.0	27.3	54	147.4	44.7	14	204.8	62.1	74	262.2	79.5
35	33.5	10.2	95	90.9	27.6	55	148.3	45.0	15	205.7	62.4	75	263.2	79.8
36	34.5	10.4	96	91.9	27.8	56	149.3	45.3	16	206.7	62.7	76	264.1	80.1
37	35.4	10.7	97	92.8	28.2	57	150.2	45.6	17	207.7	63.0	77	265.1	80.4
38	36.4	11.0	98	93.8	28.4	58	151.2	45.9	18	208.6	63.3	78	266.0	80.7
39	37.3	11.3	99	94.7	28.7	59	152.2	46.2	19	209.6	63.6	79	267.0	80.9
40	38.3	11.6	100	95.7	29.0	60	153.1	46.4	20	210.5	63.9	80	267.9	81.3
41	39.2	11.9	101	96.7	29.3	161	154.1	46.7	221	211.5	64.2	281	268.9	81.6
42	40.2	12.2	02	97.6	29.6	62	155.0	47.0	22	212.4	64.4	82	269.9	81.9
43	41.1	12.5	03	98.6	29.9	63	156.0	47.3	23	213.4	64.7	83	270.8	82.2
44	42.1	12.8	04	99.5	30.2	64	156.9	47.6	24	214.4	65.0	84	271.8	82.4
45	43.1	13.1	05	100.5	30.5	65	157.9	47.9	25	215.3	65.3	85	272.7	82.7
46	44.0	13.3	06	101.4	30.8	66	158.9	48.2	26	216.3	65.6	86	273.7	83.0
47	45.0	13.6	07	102.4	31.1	67	159.8	48.5	27	217.2	65.9	87	274.6	83.3
48	45.9	13.9	08	103.3	31.4	68	160.8	48.8	28	218.2	66.2	88	275.6	83.6
49	46.9	14.2	09	104.3	31.6	69	161.7	49.0	29	219.1	66.4	89	276.6	83.9
50	47.8	14.5	10	105.3	31.9	70	162.7	49.3	30	220.1	66.8	90	277.5	84.2
51	48.8	14.8	111	106.2	32.2	171	163.6	49.6	231	221.1	67.1	291	278.5	84.5
52	49.8	15.1	12	107.2	32.5	72	164.6	49.9	32	222.0	67.3	92	279.4	84.8
53	50.7	15.4	13	108.1	32.8	73	165.6	50.2	33	223.0	67.6	93	280.4	85.0
54	51.7	15.7	14	109.1	33.1	74	166.5	50.5	34	223.9	67.9	94	281.3	85.3
55	52.6	16.0	15	110.0	33.4	75	167.5	50.8	35	224.9	68.2	95	282.3	85.6
56	53.6	16.3	16	111.0	33.8	76	168.4	51.1	36	225.9	68.5	96	283.3	85.9
57	54.5	16.5	17	112.0	34.0	77	169.4	51.4	37	226.8	68.8	97	284.2	86.2
58	55.5	16.8	18	112.9	34.3	78	170.3	51.7	38	227.8	69.1	98	285.2	86.5
59	56.5	17.1	19	113.9	34.5	79	171.3	52.0	39	228.7	69.4	99	286.1	86.8
60	57.4	17.4	20	114.8	34.8	80	172.3	52.3	40	229.7	69.7	300	287.1	87.1
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 6 ½ Points.

TABLE I. Difference of Latitude and Departure for 1 ¼ Points.

Dift	Lat.	Dep	Dift	Lat.	Dep	Dift	Lat.	Dep	Dift	Lat.	Dep	Dift	Lat.	Dep
1	01.0	00.2	61	59.2	14.8	121	117.4	29.4	181	175.6	44.0	241	233.8	58.6
2	01.9	00.5	62	60.1	15.1	22	118.3	29.6	82	176.5	44.2	42	234.7	58.8
3	02.9	00.7	63	61.1	15.3	23	119.3	29.9	83	177.5	44.5	43	235.7	59.0
4	03.9	01.0	64	62.1	15.6	24	120.3	30.1	84	178.5	44.7	44	236.7	59.3
5	04.9	01.2	65	63.1	15.8	25	121.3	30.4	85	179.5	45.0	45	237.7	59.5
6	05.8	01.5	66	64.0	16.0	26	122.2	30.6	86	180.4	45.2	46	238.6	59.8
7	06.8	01.7	67	65.0	16.3	27	123.2	30.9	87	181.4	45.4	47	239.6	60.0
8	07.8	01.9	68	66.0	16.5	28	124.2	31.1	88	182.4	45.7	48	240.6	60.3
9	08.7	02.2	69	66.9	16.8	29	125.1	31.3	89	183.3	45.9	49	241.5	60.5
10	09.7	02.4	70	67.9	17.0	30	126.1	31.6	90	184.3	46.2	50	242.5	60.7
11	10.7	02.7	71	68.9	17.3	131	127.1	31.8	191	185.3	46.4	251	243.5	61.0
12	11.6	02.9	72	69.8	17.5	32	128.0	32.1	92	186.2	46.7	52	244.4	61.2
13	12.6	03.2	73	70.8	17.7	33	129.0	32.3	93	187.2	46.9	53	245.4	61.5
14	13.6	03.4	74	71.8	18.0	34	130.0	32.6	94	188.2	47.1	54	246.4	61.7
15	14.6	03.6	75	72.8	18.2	35	131.0	32.8	95	189.2	47.4	55	247.4	62.0
16	15.5	03.9	76	73.7	18.5	36	131.9	33.0	96	190.1	47.6	56	248.3	62.2
17	16.5	04.1	77	74.7	18.7	37	132.9	33.3	97	191.1	47.9	57	249.3	62.4
18	17.5	04.4	78	75.7	19.0	38	133.9	33.5	98	192.1	48.1	58	250.3	62.7
19	18.4	04.6	79	76.6	19.2	39	134.8	33.8	99	193.0	48.4	59	251.2	62.9
20	19.4	04.9	80	77.6	19.4	40	135.8	34.0	200	194.0	48.6	60	252.2	63.2
21	20.4	05.1	81	78.6	19.7	141	136.8	34.3	201	195.0	48.8	261	253.2	63.4
22	21.3	05.3	82	79.5	19.9	42	137.7	34.5	02	195.9	49.1	62	254.1	63.7
23	22.3	05.6	83	80.5	20.2	43	138.7	34.7	03	196.9	49.3	63	255.1	63.9
24	23.3	05.8	84	81.5	20.4	44	139.7	35.0	04	197.9	49.6	64	256.1	64.1
25	24.3	06.1	85	82.5	20.7	45	140.7	35.2	05	198.9	49.8	65	257.1	64.4
26	25.2	06.3	86	83.4	20.9	46	141.6	35.5	06	199.8	50.1	66	258.0	64.6
27	26.2	06.6	87	84.4	21.1	47	142.6	35.7	07	200.8	50.3	67	259.0	64.9
28	27.2	06.8	88	85.4	21.4	48	143.6	36.0	08	201.8	50.5	68	260.0	65.1
29	28.1	07.0	89	86.3	21.6	49	144.5	36.2	09	202.7	50.8	69	260.9	65.4
30	29.1	07.3	90	87.3	21.9	50	145.5	36.4	10	203.7	51.0	70	261.9	65.6
31	30.1	07.5	91	88.3	22.1	151	146.5	36.7	211	204.7	51.3	271	262.9	65.8
32	31.0	07.8	92	89.2	22.4	52	147.4	36.9	12	205.6	51.5	72	263.8	66.1
33	32.0	08.0	93	90.2	22.6	53	148.4	37.2	13	206.6	51.8	73	264.8	66.3
34	33.0	08.3	94	91.2	22.8	54	149.4	37.4	14	207.6	52.0	74	265.8	66.6
35	34.0	08.5	95	92.2	23.1	55	150.4	37.7	15	208.6	52.2	75	266.8	66.8
36	34.9	08.7	96	93.1	23.3	56	151.3	37.9	16	209.5	52.5	76	267.7	67.1
37	35.9	09.0	97	94.1	23.6	57	152.3	38.1	17	210.5	52.7	77	268.7	67.3
38	36.9	09.2	98	95.1	23.8	58	153.3	38.4	18	211.5	53.0	78	269.7	67.5
39	37.8	09.5	99	96.0	24.1	59	154.2	38.6	19	212.4	53.2	79	270.6	67.8
40	38.8	09.7	100	97.0	24.3	60	155.2	38.9	20	213.4	53.5	80	271.6	68.0
41	39.8	10.0	101	98.0	24.5	16	156.2	39.1	221	214.4	53.7	281	272.6	68.3
42	40.7	10.2	02	98.9	24.8	62	157.1	39.4	22	215.3	53.9	82	273.5	68.5
43	41.7	10.4	03	99.9	25.0	63	158.1	39.6	23	216.3	54.2	83	274.5	68.8
44	42.7	10.7	04	100.9	25.3	64	159.1	39.8	24	217.3	54.4	84	275.5	69.0
45	43.7	10.9	05	101.9	25.5	65	160.1	40.1	25	218.3	54.7	85	276.5	69.2
46	44.6	11.2	06	102.8	25.8	66	161.0	40.3	26	219.2	54.9	86	277.4	69.5
47	45.6	11.4	07	103.8	26.0	67	162.0	40.6	27	220.2	55.2	87	278.4	69.7
48	46.6	11.7	08	104.8	26.2	68	163.0	40.8	28	221.2	55.4	88	279.4	70.0
49	47.5	11.9	09	105.7	26.5	69	163.9	41.1	29	222.1	55.6	89	280.3	70.2
50	48.5	12.1	10	106.7	26.7	70	164.9	41.3	30	223.1	55.9	90	281.3	70.5
51	49.5	12.4	111	107.7	27.0	171	165.9	41.5	231	224.1	56.1	291	282.3	70.7
52	50.4	12.6	12	108.6	27.2	72	166.8	41.8	32	225.0	56.4	92	283.2	71.0
53	51.4	12.9	13	109.6	27.5	73	167.8	42.0	33	226.0	56.6	93	284.2	71.2
54	52.4	13.1	14	110.6	27.7	74	168.8	42.3	34	227.0	56.9	94	285.2	71.4
55	53.4	13.4	15	111.6	27.9	75	169.8	42.5	35	228.0	57.1	95	286.2	71.7
56	54.3	13.6	16	112.5	28.2	76	170.7	42.8	36	228.9	57.3	96	287.1	71.9
57	55.3	13.8	17	113.5	28.4	77	171.7	43.0	37	229.9	57.6	97	288.1	72.2
58	56.3	14.1	18	114.5	28.7	78	172.7	43.3	38	230.9	57.8	98	289.1	72.4
59	57.2	14.3	19	115.4	28.9	79	173.6	43.5	39	231.8	58.1	99	290.0	72.7
60	58.2	14.6	20	116.4	29.2	80	174.6	43.7	40	232.8	58.3	300	291.0	72.9
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

for 6 ¾ Points.

TABLE I. Difference of Latitude and Departure for 1 ½ Points.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.3	61	58.4	17.7	121	115.8	35.1	181	173.2	52.5	241	230.6	70.0
2	01.9	00.6	62	59 3	18.0	22	116.7	35.4	82	174.2	52.8	42	231.6	70.2
3	02.9	00.9	63	60.3	18.3	23	117.7	35.7	83	175.1	53.1	43	232.5	70.5
4	03.8	01.2	64	61.2	18.6	24	118.7	36.0	84	176.1	53.4	44	233.5	70.8
5	04.8	01.5	65	62.2	18.9	25	119.6	36.3	85	177.0	53.7	45	234.5	71.1
6	05.7	01.7	66	63.2	19.2	26	120.6	36.6	86	178.0	54.0	46	235.4	71.4
7	06.7	02.0	67	64.1	19.4	27	121.5	36.9	87	179.0	54.3	47	236.4	71.7
8	07.7	02.3	68	65.1	19.7	28	122.5	37.2	88	179.9	54.6	48	237.3	72.0
9	08.6	02.6	69	66.0	20.0	29	123.4	37.4	89	180.9	54.9	49	238.3	72.3
10	09.6	02.9	70	67.0	20.3	30	124.4	37.7	90	181.8	55.0	50	239.2	72.6
11	10.5	03.2	71	67.9	20.6	131	125.4	38.0	191	182.8	55.4	251	240.2	72.9
12	11.5	03.5	72	68.9	20.9	32	126.3	38.3	92	183.7	55.7	52	241.1	73.2
13	12.4	03.8	73	69.9	21 2	33	127.3	38.6	93	184.7	56.0	53	242.1	73.4
14	13.4	04.1	74	70.8	21.5	34	128.2	38.9	94	185.6	56.3	54	243.1	73.7
15	14.4	04.4	75	71.8	21.8	35	129.2	39.2	95	186.6	56.6	55	244.0	74.0
16	15.3	04.6	76	72.7	22.1	36	130.1	39.5	96	187.6	56.9	56	245.0	74.3
17	16.3	04.9	77	73.7	22.4	37	131.1	39.8	97	188.5	57.2	57	245.9	74.6
18	17.2	05.2	78	74.6	22.6	38	132.1	40.0	98	189.5	57.5	58	246.9	74.9
19	18.2	05.5	79	75.6	22.9	39	133.0	40.3	99	190.4	57.8	59	247.8	75.2
20	19.1	05.8	80	76.6	23.2	40	134 0	40.6	200	191.4	58.1	60	248.8	75.5
21	20.1	06.1	81	77.5	23.5	141	154.9	40.9	201	192.3	58.3	261	249.8	75.8
22	21.1	06.4	82	78.5	23.8	42	135.9	41.2	02	193.3	58.6	62	250.7	76.1
23	22.0	06.7	83	79.4	24.1	43	136.8	41.5	03	194 3	58.9	63	251.7	76.3
24	23.0	07.0	84	80.4	24.4	44	137.8	41.8	04	195.2	59.2	64	252.6	76.6
25	23.9	07.3	85	81.3	24.7	45	138.8	42.1	05	196.2	59.5	65	253.6	76.9
26	24.9	07.5	86	82 3	25.0	46	139.7	42.4	06	197.1	59.8	66	234.5	77.2
27	25.9	07.8	87	83.3	25.2	47	140.7	42.7	07	198.1	60.1	67	255.5	77.5
28	26.8	08.1	88	84.2	25.5	48	141.6	43.0	08	199.0	60 4	68	256.5	77.8
29	27.8	08.4	89	85.2	25.8	49	142.6	43.3	09	200.0	60.7	69	257.4	78.1
30	28.7	08.7	90	86.1	26.1	50	143.5	43.5	10	201.0	61.0	70	258.4	78.4
31	29.7	09.0	91	87.1	26.4	151	144.5	43.8	211	201.9	61.2	271	259.3	78.7
32	30.6	09.3	92	88.0	26.7	52	145.5	44.1	12	202.9	61.5	72	260.3	78.9
33	31.6	09.6	93	89.0	27.0	53	146.4	44.4	13	203.8	61.8	73	261.2	79.2
34	32.5	09.9	94	90.0	27.3	54	147.4	44.7	14	204.8	62.1	74	262.2	79.5
35	33.5	10.2	95	90.9	27.6	55	148.3	45.0	15	205.7	62.4	75	263.2	79.8
36	34.5	10.4	96	91.9	27.8	56	149.3	45.3	16	206.7	62.7	76	264.1	80.1
37	35.4	10.7	97	92.8	28.2	57	150.2	45.6	17	207.7	63.0	77	265.1	80.4
38	36.4	11.0	98	93.8	28.4	58	151.2	45.9	18	208.6	63.3	78	266.0	80.7
39	37.3	11.3	99	94.7	28.7	59	152.2	46.2	19	209.6	63.6	79	267.0	80.9
40	38.3	11.6	100	95.7	29.0	60	153.1	46.4	20	210.5	63.9	80	267.9	81.3
41	39.2	11.9	101	96.7	29.3	161	154.1	46.7	221	211.5	64.2	281	268.9	81.6
42	40.2	12.2	02	97.6	29.6	62	155.0	47.0	22	212.4	64.4	82	269.9	81.9
43	41.1	12.5	03	98.6	29.9	63	156.0	47.3	23	213.4	64.7	83	270.8	82.2
44	42.1	12.8	04	99.5	30.2	64	156.9	47.6	24	214.4	65.0	84	271.8	82.4
45	43.1	13.1	05	100.5	30.5	65	157.9	47.9	25	215.3	65.3	85	272.7	82.7
46	44.0	13.3	06	101.4	30.8	66	158.9	48.2	26	216.3	65.6	86	273.7	83.0
47	45.0	13.6	07	102.4	31.1	67	159.8	48.5	27	217.2	65.9	87	274.6	83.3
48	45.9	13.9	08	103.3	31.4	68	160.8	48.8	28	218.2	66.2	88	275.6	83.6
49	46.9	14.2	09	104.3	31.6	69	161.7	49.0	29	219.1	66.4	89	276.6	83.9
50	47.8	14.5	10	105.3	31.9	70	162.7	49.3	30	220.1	66.8	90	277.5	84.2
51	48.8	14.8	111	106.2	32.2	171	163.6	49.6	231	221.1	67.1	291	278.5	84.5
52	49.8	15.1	12	107.2	32.5	72	164.6	49.9	32	222.0	67.3	92	279.4	84.8
53	50.7	15.4	13	108.1	32.8	73	165.6	50.2	33	223.0	67.6	93	280.4	85.0
54	51.7	15.7	14	109.1	33.1	74	166.5	50.5	34	223.9	67.9	94	281.3	85.3
55	52.6	16.0	15	110.0	33.4	75	167.5	50.8	35	224.9	68.2	95	282.3	85.6
56	53.6	16.3	16	111.0	33.8	76	168.4	51.1	36	225.9	68.5	96	283.3	85.9
57	54.5	16.5	17	112.0	34.0	77	169.4	51.4	37	226.8	68.8	97	284.2	86.2
58	55.5	16.8	18	112.9	34.3	78	170.3	51.7	38	227.8	69.1	98	285.2	86.5
59	56.5	17.1	19	113.9	34.5	79	171.3	52.0	39	228.7	69.4	99	286.1	86.8
60	57.4	17.4	20	114.8	34.8	80	172.3	52.3	40	229.7	69.7	300	287.1	87.1
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 6 ½ Points.

Table I. Difference of Latitude and Departure for 1¾ Points.

Dist	Lat.	Dep	Dist	Lat.	Dep	Dist	Lat.	Dep	Dist	Lat.	Dep	Dist	Lat.	Dep.
1	00.9	00.3	61	57.4	20.5	121	113.9	40.8	181	170.4	61.0	241	226.9	81.2
2	01.9	00.7	62	58.4	20.9	22	114.9	41.1	82	171.4	61.3	42	227.9	81.5
3	02.8	01.0	63	59.3	21.2	23	115.8	41.4	83	172.3	61.7	43	228.8	81.9
4	03.8	01.3	64	60.3	21.6	24	116.8	41.8	84	173.2	62.0	44	229.7	82.2
5	04.7	01.7	65	61.2	21.9	25	117.7	42.1	85	174.2	62.3	45	230.7	82.5
6	05.6	02.0	66	62.1	22.2	26	118.6	42.4	86	175.1	62.7	46	231.6	82.9
7	06.6	02.4	67	63.1	22.6	27	119.6	42.8	87	176.1	63.0	47	232.6	83.2
8	07.5	02.7	68	64.0	22.9	28	120.5	43.1	88	177.0	63.3	48	233.5	83.5
9	08.5	03.0	69	65.0	23.2	29	121.5	43.5	89	177.9	63.7	49	234.4	83.9
10	09.4	03.4	70	65.9	23.6	30	122.4	43.8	90	178.9	64.0	50	235.4	84.2
11	10.4	03.7	71	66.8	23.9	131	123.3	44.1	191	179.8	64.3	251	236.3	84.6
12	11.3	04.0	72	67.8	24.3	32	124.3	44.5	92	180.8	64.7	52	237.3	84.9
13	12.2	04.4	73	68.7	24.6	33	125.2	44.8	93	181.7	65.0	53	238.2	85.2
14	13.2	04.7	74	69.7	24.9	34	126.2	45.1	94	182.7	65.4	54	239.2	85.6
15	14.1	05.1	75	70.6	25.3	35	127.1	45.5	95	183.6	65.7	55	240.1	85.9
16	15.1	05.4	76	71.6	25.6	36	128.0	45.8	96	184.5	66.0	56	241.0	86.2
17	16.0	05.7	77	72.5	25.9	37	129.0	46.2	97	185.5	66.4	57	242.0	86.6
18	17.0	06.1	78	73.4	26.3	38	129.9	46.5	98	186.4	66.7	58	242.9	86.9
19	17.9	06.4	79	74.4	26.6	39	130.9	46.8	99	187.4	67.0	59	243.9	87.2
20	18.8	06.7	80	75.3	27.0	40	131.8	47.2	200	188.3	67.4	60	244.8	87.6
21	19.8	07.1	81	76.3	27.3	141	132.8	47.5	201	189.3	67.7	261	245.7	87.9
22	20.7	07.4	82	77.2	27.6	42	133.7	47.8	02	190.2	68.1	62	246.7	88.3
23	21.7	07.7	83	78.1	28.0	43	134.6	48.2	03	191.1	68.4	63	247.6	88.6
24	22.6	08.1	84	79.1	28.3	44	135.6	48.5	04	192.1	68.7	64	248.6	88.9
25	23.5	08.4	85	80.0	28.6	45	136.5	48.8	05	193.0	69.1	65	249.5	89.3
26	24.5	08.8	86	81.0	29.0	46	137.5	49.2	06	194.0	69.4	66	250.5	89.6
27	25.4	09.1	87	81.9	29.3	47	138.4	49.5	07	194.9	69.7	67	251.4	89.9
28	26.4	09.4	88	82.9	29.6	48	139.3	49.9	08	195.8	70.1	68	252.3	90.3
29	27.3	09.8	89	83.8	30.0	49	140.3	50.2	09	196.8	70.4	69	253.3	90.6
30	28.2	10.1	90	84.7	30.3	50	141.2	50.5	10	197.7	70.7	70	254.2	90.9
31	29.2	10.4	91	85.7	30.7	151	142.2	50.9	211	198.7	71.1	271	255.2	91.3
32	30.1	10.8	92	86.6	31.0	52	143.1	51.2	12	199.6	71.5	72	256.1	91.6
33	31.1	11.1	93	87.6	31.3	53	144.1	51.5	13	200.5	71.7	73	257.0	92.0
34	32.0	11.5	94	88.5	31.7	54	145.0	51.9	14	201.5	72.1	74	258.0	92.3
35	33.0	11.8	95	89.4	32.0	55	145.9	52.2	15	202.4	72.4	75	258.9	92.6
36	33.9	12.1	96	90.4	32.3	56	146.9	52.6	16	203.4	72.8	76	259.9	93.0
37	34.8	12.5	97	91.3	32.7	57	147.8	52.9	17	204.3	73.1	77	260.8	93.3
38	35.8	12.8	98	92.3	33.0	58	148.8	53.2	18	205.2	73.4	78	261.7	93.7
39	36.7	13.1	99	93.2	33.4	59	149.7	53.6	19	206.2	73.8	79	262.7	94.0
40	37.7	13.5	100	94.2	33.7	60	150.6	53.9	20	207.1	74.1	80	263.6	94.3
41	38.6	13.8	101	95.1	34.0	161	151.6	54.2	221	208.1	74.5	281	264.6	94.7
42	39.5	14.1	02	96.0	34.4	62	152.5	54.6	22	209.0	74.8	82	265.5	95.0
43	40.5	14.5	03	97.0	34.7	63	153.5	54.9	23	210.0	75.1	83	266.5	95.3
44	41.4	14.8	04	97.9	35.0	64	154.4	55.2	24	210.9	75.5	84	267.4	95.7
45	42.4	15.2	05	98.9	35.4	65	155.4	55.6	25	211.8	75.8	85	268.3	96.0
46	43.3	15.5	06	99.8	35.7	66	156.3	55.9	26	212.8	76.1	86	269.3	96.4
47	44.3	15.8	07	100.7	36.0	67	157.2	56.2	27	213.7	76.5	87	270.2	96.7
48	45.2	16.2	08	101.7	36.4	68	158.2	56.6	28	214.7	76.8	88	271.2	97.0
49	46.1	16.5	09	102.6	36.7	69	159.1	56.9	29	215.6	77.1	89	272.1	97.4
50	47.1	16.8	10	103.6	37.1	70	160.1	57.3	30	216.6	77.5	90	273.0	97.7
51	48.0	17.2	111	104.5	37.4	171	161.0	57.6	231	217.5	77.8	291	274.0	98.0
52	49.0	17.5	12	105.5	37.7	72	161.9	57.9	32	218.4	78.2	92	274.9	98.4
53	49.9	17.9	13	106.4	38.1	73	162.9	58.3	33	219.4	78.5	93	275.9	98.7
54	50.8	18.2	14	107.3	38.4	74	163.8	58.6	34	220.3	78.8	94	276.8	99.0
55	51.8	18.5	15	108.3	38.7	75	164.8	59.0	35	221.3	79.2	95	277.8	99.4
56	52.7	18.9	16	109.2	39.1	76	165.7	59.3	36	222.2	79.5	96	278.7	99.7
57	53.7	19.2	17	110.2	39.4	77	166.7	59.6	37	223.1	79.8	97	279.6	100.1
58	54.6	19.5	18	111.1	39.8	78	167.6	60.0	38	224.1	80.2	98	280.6	100.4
59	55.5	19.9	19	112.0	40.1	79	168.5	60.3	39	225.0	80.5	99	281.5	100.7
60	56.5	20.2	20	113.0	40.4	80	169.5	60.6	40	226.0	80.8	300	282.5	101.1
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 6 ¼ Points.

TABLE I. Difference of Latitude and Departure for 2 ½ Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.5	61	53.8	28.8	121	106.7	57.0	181	159.6	85.3	241	212.5	113.6
2	01.8	00.9	62	54.7	29.2	22	107.6	57.5	82	160.5	85.8	42	213.4	114.1
3	02.6	01.4	63	55.6	29.7	23	108.5	58.0	83	161.4	86.3	43	214.3	114.5
4	03.5	01.9	64	56.4	30.2	24	109.4	58.5	84	162.3	86.7	44	215.2	115.0
5	04.4	02.4	65	57.3	30.6	25	110.2	58.9	85	163.2	87.2	45	216.1	115.8
6	05.3	02.8	66	58.2	31.1	26	111.1	59.4	86	164.0	87.7	46	217.0	116.0
7	06.2	03.3	67	59.1	31.6	27	112.0	59.9	87	164.9	88.2	47	217.8	116.4
8	07.1	03.8	68	60.0	32.0	28	112.9	60.3	88	165.8	88.6	48	218.7	116.9
9	07.9	04.2	69	60.9	32.5	29	113.8	60.8	89	166.7	89.1	49	219.6	117.4
10	08.8	04.7	70	61.7	33.0	30	114.6	61.3	90	167.6	89.6	50	220.5	117.8
11	09.7	05.2	71	62.6	33.5	131	115.5	61.8	191	168.4	90.0	251	221.4	118.3
12	10.6	05.7	72	63.5	33.9	32	116.4	62.2	92	169.3	90.5	52	222.2	118.7
13	11.5	06.1	73	64.4	34.4	33	117.3	62.7	93	170.2	91.0	53	223.1	119.3
14	12.3	06.6	74	65.3	34.9	34	118.2	63.2	94	171.1	91.4	54	224.0	119.7
15	13.2	07.1	75	66.1	35.4	35	119.1	63.6	95	172.0	91.9	55	224.9	120.2
16	14.1	07.5	76	67.0	35.8	36	119.9	64.1	96	172.9	92.4	56	225.8	120.7
17	15.0	08.0	77	67.9	36.3	37	120.8	64.6	97	173.7	92.9	57	226.7	121.1
18	15.9	08.5	78	68.8	36.8	38	121.7	65.1	98	174.6	93.3	58	227.5	121.6
19	16.8	09.0	79	69.7	37.2	39	122.6	65.5	99	175.5	93.8	59	228.4	122.1
20	17.6	09.4	80	70.6	37.7	40	123.5	66.0	200	176.4	94.3	60	229.3	122.6
21	18.5	09.9	81	71.4	38.2	141	124.4	66.5	201	177.3	94.8	261	230.2	123.0
22	19.4	10.4	82	72.3	38.7	42	125.2	66.9	02	178.1	95.2	62	231.1	123.5
23	20.3	10.8	83	73.2	39.1	43	126.1	67.4	03	179.0	95.7	63	231.9	124.0
24	21.2	11.3	84	74.1	39.6	44	127.0	67.9	04	179.9	96.2	64	232.8	124.4
25	22.0	11.8	85	75.0	40.1	45	127.9	68.4	05	180.8	96.6	65	233.7	124.9
26	22.9	12.3	86	75.8	40.5	46	128.8	68.8	06	181.7	97.1	66	234.6	125.4
27	23.8	12.7	87	76.7	41.0	47	129.6	69.3	07	182.6	97.6	67	235.5	125.9
28	24.7	13.2	88	77.6	41.5	48	130.5	69.8	08	183.4	98.0	68	236.4	126.3
29	25.6	13.7	89	78.5	42.0	49	131.4	70.2	09	184.3	98.5	69	237.2	126.8
30	26.5	14.1	90	79.4	42.4	50	132.3	70.7	10	185.2	99.0	70	238.1	127.3
31	27.3	14.6	91	80.3	42.9	151	133.2	71.2	211	186.1	99.5	271	239.0	127.7
32	28.2	15.1	92	81.1	43.4	52	134.1	71.7	12	187.0	99.9	72	239.9	128.2
33	29.1	15.5	93	82.0	43.8	53	134.9	72.1	13	187.8	100.4	73	240.8	128.7
34	30.0	16.0	94	82.9	44.3	54	135.8	72.6	14	188.7	100.9	74	241.6	129.2
35	30.9	16.5	95	83.8	44.8	55	136.7	73.1	15	189.6	101.4	75	242.5	129.6
36	31.7	17.0	96	84.7	45.3	56	137.6	73.5	16	190.5	101.8	76	243.4	130.1
37	32.6	17.4	97	85.5	45.7	57	138.5	74.0	17	191.4	102.3	77	244.3	130.6
38	33.5	17.9	98	86.4	46.2	58	139.3	74.5	18	192.3	102.8	78	245.2	131.0
39	34.4	18.4	99	87.3	46.7	59	140.2	75.0	19	193.1	103.2	79	246.1	131.5
40	35.3	18.9	100	88.2	47.1	60	141.1	75.4	20	194.0	103.7	80	246.9	132.0
41	36.2	19.3	101	89.1	47.6	161	142.0	75.9	221	194.9	104.2	281	247.8	132.5
42	37.0	19.8	02	90.0	48.1	62	142.9	76.4	22	195.8	104.7	82	248.7	132.9
43	37.9	20.3	03	90.8	48.6	63	143.8	76.8	23	196.7	105.1	83	249.6	133.4
44	38.8	20.7	04	91.7	49.0	64	144.6	77.3	24	197.6	105.6	84	250.5	133.9
45	39.7	21.2	05	92.6	49.5	65	145.5	77.8	25	198.4	106.1	85	251.4	134.3
46	40.6	21.7	06	93.5	50.0	66	146.4	78.3	26	199.3	106.5	86	252.2	134.8
47	41.5	22.1	07	94.4	50.4	67	147.3	78.7	27	200.2	107.0	87	253.1	135.3
48	42.3	22.6	08	95.2	50.9	68	148.2	79.2	28	201.1	107.5	88	254.0	135.8
49	43.2	23.1	09	96.1	51.4	69	149.0	79.7	29	202.0	107.9	89	254.9	136.2
50	44.1	23.6	10	97.0	51.9	70	149.9	80.1	30	202.8	108.4	90	255.8	136.7
51	45.0	24.0	111	97.9	52.3	171	150.8	80.6	231	203.7	108.9	291	256.6	137.2
52	45.9	24.5	12	98.8	52.8	72	151.7	81.1	32	204.6	109.4	92	257.5	137.6
53	46.7	25.0	13	99.7	53.3	73	152.6	81.6	33	205.5	109.8	93	258.4	138.1
54	47.6	25.5	14	100.5	53.7	74	153.5	82.0	34	206.4	110.3	94	259.3	138.6
55	48.5	25.9	15	101.4	54.2	75	154.3	82.5	35	207.3	110.8	95	260.2	139.1
56	49.4	26.4	16	102.3	54.7	76	155.2	83.0	36	208.1	111.2	96	261.0	139.5
57	50.3	26.9	17	103.2	55.2	77	156.1	83.4	37	209.0	111.7	97	261.9	140.0
58	51.2	27.3	18	104.1	55.6	78	157.0	83.9	38	209.9	112.2	98	262.8	140.5
59	52.0	27.8	19	104.0	56.1	79	157.9	84.4	39	210.8	112.7	99	263.7	140.9
60	52.9	28.3	20	105.8	56.6	80	158.8	84.9	40	211.7	113.1	300	264.6	141.4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 5 ½ Points.

TABLE I. Difference of Latitude and Departure for 2 $\frac{3}{4}$ Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.4	61	55.1	26.1	121	109.4	51.7	181	163.6	77.4	241	217.9	103.0
2	01.8	00.9	62	56.0	26.5	22	110.3	52.2	82	164.5	77.8	42	218.8	103.5
3	02.7	01.3	63	57.0	26.9	23	111.2	52.6	83	165.4	78.2	43	219.7	103.9
4	03.6	01.7	64	57.9	27.4	24	112.1	53.0	84	166.3	78.7	44	220.6	104.3
5	04.5	02.1	65	58.8	27.8	25	113.0	53.4	85	167.2	79.1	45	221.5	104.8
6	05.4	02.6	66	59.7	28.2	26	113.9	53.9	86	168.1	79.5	46	222.4	105.2
7	06.3	03.0	67	60.6	28.6	27	114.8	54.3	87	169.0	80.0	47	223.3	105.6
8	07.2	03.4	68	61.5	29.1	28	115.7	54.7	88	169.9	80.4	48	224.2	106.0
9	08.1	03.8	69	62.4	29.5	29	116.6	55.2	89	170.8	80.8	49	225.1	106.5
10	09.0	04.3	70	63.3	29.9	30	117.5	55.6	90	171.8	81.2	50	226.0	106.9
11	09.9	04.7	71	64.2	30.4	131	118.4	56.0	191	172.7	81.7	251	226.9	107.3
12	10.8	05.1	72	65.1	30.8	32	119.3	56.4	92	173.6	82.1	52	227.8	107.7
13	11.8	05.6	73	66.0	31.2	33	120.2	56.9	93	174.5	82.5	53	228.7	108.2
14	12.7	06.0	74	66.9	31.6	34	121.1	57.3	94	175.4	82.9	54	229.6	108.6
15	13.6	06.4	75	67.8	32.1	35	122.0	57.7	95	176.3	83.4	55	230.5	109.0
16	14.5	06.8	76	68.7	32.5	36	122.9	58.1	96	177.2	83.8	56	231.4	109.5
17	15.4	07.3	77	69.6	32.9	37	123.8	58.6	97	178.1	84.2	57	232.3	109.9
18	16.3	07.7	78	70.3	33.5	38	124.8	59.0	98	179.0	84.7	58	233.2	110.3
19	17.2	08.1	79	71.4	33.8	39	125.7	59.4	99	179.9	85.1	59	234.1	110.7
20	18.1	08.6	80	72.3	34.2	40	126.6	59.9	200	180.8	85.5	60	235.0	111.2
21	19.0	09.0	81	73.2	34.6	141	127.5	60.3	201	181.7	85.9	261	235.9	111.6
22	19.9	09.4	82	74.1	35.1	42	128.4	60.7	02	182.6	86.4	62	236.8	112.0
23	20.8	09.8	83	75.0	35.5	43	129.3	61.1	03	183.5	86.8	63	237.7	112.4
24	21.7	10.3	84	75.9	35.9	44	130.2	61.6	04	184.4	87.2	64	238.7	112.9
25	22.6	10.7	85	76.8	36.3	45	131.1	62.0	05	185.3	87.6	65	239.6	113.3
26	23.5	11.1	86	77.7	36.8	46	132.0	62.4	06	186.2	88.1	66	240.5	113.7
27	24.4	11.5	87	78.6	37.2	47	132.9	62.9	07	187.1	88.5	67	241.4	114.2
28	25.3	12.0	88	79.6	37.6	48	133.8	63.3	08	188.0	88.9	68	242.3	114.6
29	26.2	12.4	89	80.5	38.1	49	134.7	63.7	09	188.9	89.4	69	243.2	115.0
30	27.1	12.8	90	81.4	38.5	50	135.6	64.1	10	189.8	89.8	70	244.1	115.4
31	28.0	13.3	91	82.3	38.9	151	136.5	64.6	211	190.7	90.2	271	245.0	115.9
32	28.9	13.7	92	83.2	39.3	52	137.4	65.0	12	191.6	90.6	72	245.9	116.3
33	29.8	14.1	93	84.1	39.8	53	138.3	65.4	13	192.5	91.1	73	246.8	116.7
34	30.7	14.5	94	85.0	40.2	54	139.2	65.8	14	193.5	91.5	74	247.7	117.2
35	31.6	15.0	95	85.9	40.6	55	140.1	66.3	15	194.4	91.9	75	248.6	117.6
36	32.5	15.4	96	86.8	41.0	56	141.0	66.7	16	195.3	92.4	76	249.5	118.0
37	33.4	15.8	97	87.7	41.5	57	141.9	67.1	17	196.2	92.8	77	250.4	118.4
38	34.4	16.2	98	88.6	41.9	58	142.8	67.6	18	197.1	93.2	78	251.3	118.9
39	35.3	16.7	99	89.5	42.3	59	143.7	68.0	19	198.0	93.6	79	252.2	119.3
40	36.2	17.1	100	90.4	42.8	60	144.6	68.4	20	198.9	94.1	80	253.1	119.7
41	37.1	17.5	101	91.3	43.2	161	145.5	68.8	221	199.8	94.5	281	254.0	120.1
42	38.0	18.0	02	92.2	43.6	62	146.4	69.3	22	200.7	94.9	82	254.9	120.6
43	38.9	18.4	03	93.1	44.0	63	147.4	69.7	23	201.6	95.3	83	255.8	121.0
44	39.8	18.8	04	94.0	44.5	64	148.3	70.1	24	202.5	95.8	84	256.7	121.4
45	40.7	19.2	05	94.9	44.9	65	149.2	70.5	25	203.4	96.2	85	257.6	121.9
46	41.6	19.7	06	95.8	45.3	66	150.0	71.0	26	204.3	96.6	86	258.5	122.3
47	42.5	20.1	07	96.7	45.7	67	151.0	71.4	27	205.2	97.1	87	259.4	122.7
48	43.4	20.5	08	97.6	46.2	68	151.9	71.8	28	206.1	97.5	88	260.3	123.1
49	44.3	21.0	09	98.5	46.6	69	152.8	72.3	29	207.0	97.9	89	261.3	123.6
50	45.2	21.4	10	99.4	47.0	70	153.7	72.7	30	207.9	98.3	90	262.2	124.0
51	46.1	21.8	111	100.3	47.5	171	154.6	73.1	231	208.8	98.8	291	263.1	124.4
52	47.0	22.2	12	101.2	47.9	72	155.5	73.5	32	209.7	99.2	92	264.0	124.8
53	47.9	22.7	13	102.2	48.3	73	156.4	74.0	33	210.6	99.6	93	264.9	125.3
54	48.8	23.1	14	104.1	48.7	74	157.3	74.4	34	211.5	100.1	94	265.8	125.7
55	49.7	23.5	15	104.0	49.2	75	158.2	74.8	35	212.4	100.5	95	266.7	126.1
56	50.6	23.9	16	102.9	49.6	76	159.1	75.2	36	213.3	100.9	96	267.6	126.6
57	51.5	24.4	17	105.8	50.0	77	160.0	75.7	37	214.2	101.3	97	268.5	127.0
58	52.4	24.8	18	106.7	50.5	78	160.9	76.1	38	215.1	101.8	98	269.4	127.4
59	53.3	25.2	19	107.6	50.9	79	161.8	76.5	39	216.1	102.2	99	270.3	127.8
60	54.2	25.7	20	108.5	51.3	80	162.7	77.0	40	217.0	102.6	300	271.2	128.3
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 5 $\frac{1}{4}$ Points.

TABLE I. Difference of Latitude and Departure for 3 Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	50.7	33.9	121	100.6	67.2	181	150.5	100.5	241	200.4	133.9
2	01.7	01.1	62	51.6	34.4	22	101.4	67.8	82	151.3	101.1	42	201.2	134.4
3	02.5	01.7	63	52.4	35.0	23	102.3	68.3	83	152.1	101.7	43	202.0	135.0
4	03.3	02.2	64	53.2	35.6	24	103.1	68.9	84	153.0	102.2	44	202.9	135.5
5	04.2	02.8	65	54.0	36.1	25	103.9	69.4	85	153.8	102.8	45	203.7	136.1
6	05.0	03.3	66	54.9	36.7	26	104.8	70.0	86	154.7	103.3	46	204.5	136.7
7	05.8	03.9	67	55.7	37.2	27	105.6	70.5	87	155.5	103.9	47	205.3	137.2
8	06.7	04.4	68	56.5	37.8	28	106.4	71.1	88	156.3	104.4	48	206.2	137.8
9	07.5	05.0	69	57.4	38.3	29	107.3	71.7	89	157.1	105.0	49	207.0	138.3
10	08.3	05.6	70	58.2	38.9	30	108.1	72.2	90	158.0	105.5	50	207.9	138.9
11	09.1	06.1	71	59.0	39.4	131	108.9	72.8	191	158.8	106.1	251	208.7	139.4
12	10.0	06.7	72	59.9	40.0	32	109.8	73.3	92	159.6	106.7	52	209.5	140.0
13	10.8	07.2	73	60.7	40.6	33	110.6	73.9	93	160.5	107.2	53	210.4	140.5
14	11.6	07.8	74	61.5	41.1	34	111.4	74.4	94	161.3	107.8	54	211.2	141.1
15	12.5	08.3	75	62.4	41.7	35	112.2	75.0	95	162.1	108.3	55	212.0	141.7
16	13.3	08.9	76	63.2	42.2	36	113.1	75.5	96	163.0	108.9	56	212.9	142.2
17	14.1	09.4	77	64.0	42.8	37	113.9	76.1	97	163.8	109.4	57	213.7	142.8
18	15.0	10.0	78	64.9	43.3	38	114.7	76.7	98	164.6	110.0	58	214.5	143.3
19	15.8	10.6	79	65.7	43.9	39	115.6	77.2	99	165.5	110.5	59	215.4	143.9
20	16.6	11.1	80	66.5	44.4	40	116.4	77.8	200	166.3	111.1	60	216.2	144.4
21	17.5	11.7	81	67.3	45.0	141	117.2	78.3	201	167.1	111.7	261	217.0	145.0
22	18.3	12.2	82	68.2	45.6	42	118.1	78.9	02	168.0	112.2	62	217.8	145.5
23	19.1	12.8	83	69.0	46.1	43	118.9	79.4	03	168.8	112.8	63	218.7	146.1
24	20.0	13.3	84	69.8	46.7	44	119.7	80.0	04	169.6	113.3	64	219.5	146.7
25	20.8	13.9	85	70.7	47.2	45	120.6	80.5	05	170.5	113.9	65	220.3	147.2
26	21.6	14.4	86	71.5	47.8	46	121.4	81.1	06	171.3	114.4	66	221.2	147.8
27	22.4	15.0	87	72.3	48.3	47	122.2	81.7	07	172.1	115.0	67	222.0	148.3
28	23.3	15.6	88	73.2	48.9	48	123.1	82.2	08	172.9	115.5	68	222.8	148.9
29	24.1	16.1	89	74.0	49.4	49	123.9	82.8	09	173.8	116.1	69	223.7	149.4
30	24.9	16.7	90	74.8	50.0	50	124.7	83.3	10	174.6	116.7	70	224.5	150.0
31	25.8	17.2	91	75.7	50.6	151	125.6	83.9	211	175.4	117.2	271	225.3	150.5
32	26.6	17.8	92	76.5	51.1	52	126.4	84.4	12	176.3	117.8	72	226.2	151.1
33	27.4	18.3	93	77.3	51.7	53	127.2	85.0	13	177.1	118.3	73	227.0	151.7
34	28.3	18.9	94	78.2	52.2	54	128.0	85.5	14	177.9	118.9	74	227.8	152.2
35	29.1	19.4	95	79.0	52.8	55	128.9	86.1	15	178.8	119.4	75	228.7	152.8
36	29.9	20.0	96	79.8	53.3	56	129.7	86.7	16	179.6	120.0	76	229.5	153.3
37	30.8	20.6	97	80.7	53.9	57	130.5	87.2	17	180.4	120.5	77	230.3	153.9
38	31.6	21.1	98	81.5	54.4	58	131.4	87.8	18	181.3	121.1	78	231.1	154.4
39	32.4	21.7	99	82.3	55.0	59	132.2	88.3	19	182.1	121.7	79	232.0	155.0
40	33.3	22.2	100	83.1	55.6	60	133.0	88.9	20	182.9	122.2	80	232.8	155.5
41	34.1	22.8	101	84.0	56.1	161	133.9	89.4	221	183.8	122.8	281	433.6	156.1
42	34.9	23.3	02	84.8	56.7	62	134.7	90.0	22	184.6	123.3	82	234.5	156.7
43	35.8	23.9	03	85.6	57.2	63	135.5	90.5	23	185.4	123.9	83	235.3	157.2
44	36.6	24.4	04	86.5	57.8	64	136.4	91.1	24	186.2	124.4	84	236.1	157.8
45	37.4	25.0	05	87.3	58.3	65	137.2	91.7	25	187.1	125.0	85	237.0	158.3
46	38.2	25.6	06	88.1	58.9	66	138.0	92.2	26	187.9	125.5	86	237.8	158.9
47	39.1	26.1	07	89.0	59.4	67	138.9	92.8	27	188.7	126.1	87	238.6	159.4
48	39.9	26.7	08	89.8	60.0	68	139.7	93.3	28	189.6	126.7	88	239.5	160.0
49	40.7	27.2	09	90.6	60.6	69	140.5	93.9	29	190.4	127.2	89	240.3	160.5
50	41.6	27.8	10	91.5	61.1	70	141.3	94.4	30	191.2	127.8	90	241.1	161.1
51	42.4	28.3	111	92.3	61.7	171	142.2	95.0	231	192.1	128.3	291	242.0	161.7
52	43.2	28.9	12	93.1	62.2	72	143.0	95.5	32	192.9	128.9	92	242.8	162.2
53	44.1	29.4	13	94.0	62.8	73	143.8	96.1	33	193.7	129.4	93	243.6	162.8
54	44.9	30.0	14	94.8	63.3	74	144.7	96.7	34	194.6	130.0	94	244.5	163.3
55	45.7	30.6	15	95.6	63.9	75	145.5	97.2	35	195.4	130.5	95	245.3	163.9
56	46.6	31.1	16	96.5	64.4	76	146.3	97.8	36	196.2	131.1	96	246.1	164.4
57	47.4	31.7	17	97.3	65.0	77	147.2	98.3	37	197.1	131.7	97	246.9	165.0
58	48.2	32.2	18	98.1	65.5	78	148.0	98.9	38	197.9	132.2	98	247.8	165.5
59	49.1	32.8	19	98.9	66.1	79	148.8	99.4	39	198.7	132.8	99	248.6	166.1
60	49.9	33.3	20	99.8	66.7	80	149.7	100.0	40	199.6	133.3	300	249.4	166.7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 5 Points.

TABLE I. Difference of Latitude and Departure for 2 ¾ Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.5	61	52.3	31.4	121	103.8	62.2	181	155.2	93.1	241	206.7	123.9
2	01.7	01.0	62	53.2	31.9	22	104.6	62.7	82	156.1	93.6	42	207.6	124.4
3	02.6	01.5	63	54.0	32.4	23	105.5	63.2	83	157.0	94.1	43	208.4	124.9
4	03.4	02.1	64	54.9	32.9	24	106.4	63.7	84	157.8	94.6	44	209.3	125.4
5	04.3	02.6	65	55.8	33.4	25	107.2	64.3	85	158.7	95.1	45	210.1	126.0
6	05.1	03.1	66	56.6	33.9	26	108.1	64.8	86	159.5	95.6	46	211.0	126.5
7	06.0	03.6	67	57.5	34.4	27	108.9	65.3	87	160.4	96.1	47	211.9	127.0
8	06.9	04.1	68	58.3	35.0	28	109.8	65.8	88	161.3	96.7	48	212.7	127.5
9	07.7	04.6	69	59.2	35.5	29	110.6	66.3	89	162.1	97.2	49	213.6	128.0
10	08.6	05.1	70	60.0	36.0	30	111.5	66.8	90	163.0	97.7	50	214.4	128.5
11	09.4	05.7	71	60.9	36.5	131	112.4	67.3	191	163.8	98.2	251	215.3	129.0
12	10.3	06.2	72	61.8	37.0	32	113.2	67.9	92	164.7	98.7	52	216.1	129.6
13	11.2	06.7	73	62.6	37.5	33	114.1	68.4	93	165.5	99.2	53	217.0	130.1
14	12.0	07.2	74	63.5	38.1	34	114.9	68.9	94	166.4	99.7	54	217.9	130.6
15	12.9	07.7	75	64.3	38.6	35	115.8	69.4	95	167.3	100.2	55	218.7	131.1
16	13.7	08.2	76	65.2	39.1	36	116.7	69.9	96	168.1	100.8	56	219.6	131.6
17	14.6	08.7	77	66.0	39.6	37	117.5	70.4	97	169.0	101.3	57	220.4	132.1
18	15.4	09.3	78	66.9	40.1	38	118.4	70.9	98	169.8	101.8	58	221.3	132.6
19	16.3	09.8	79	67.8	40.6	39	119.2	71.5	99	170.7	102.3	59	222.2	133.2
20	17.2	10.3	80	68.6	41.1	40	120.1	72.0	200	171.5	102.8	60	223.0	133.7
21	18.0	10.8	81	69.5	41.6	141	120.9	72.5	201	172.4	103.3	261	223.9	134.2
22	18.9	11.3	82	70.3	42.2	42	121.8	73.0	02	173.3	103.8	62	224.7	134.7
23	19.7	11.8	83	71.2	42.7	43	122.7	73.5	03	174.1	104.4	63	225.6	135.2
24	20.6	12.3	84	72.0	43.2	44	123.5	74.0	04	175.0	104.9	64	226.4	135.7
25	21.4	12.9	85	72.9	43.7	45	124.4	74.5	05	175.8	105.4	65	227.3	136.2
26	22.3	13.4	86	73.8	44.2	46	125.2	75.1	06	176.7	105.9	66	228.2	136.7
27	23.2	13.9	87	74.6	44.7	47	126.1	75.6	07	177.5	106.4	67	229.0	137.3
28	24.0	14.4	88	75.5	45.2	48	126.9	76.1	08	178.4	106.9	68	229.9	137.8
29	24.9	14.9	89	76.3	45.8	49	127.8	76.6	09	179.3	107.4	69	230.7	138.3
30	25.7	15.4	90	77.2	46.3	50	128.7	77.1	10	180.1	108.0	70	231.6	138.8
31	26.6	15.9	91	78.1	46.8	151	129.5	77.6	211	181.0	108.5	271	232.4	139.3
32	27.4	16.5	92	78.9	47.3	52	130.4	78.1	12	181.8	109.0	72	233.3	139.8
33	28.3	17.0	93	79.8	47.8	53	131.2	78.7	13	182.7	109.5	73	234.2	140.3
34	29.2	17.5	94	80.6	48.3	54	132.1	79.8	14	183.6	110.0	74	235.0	140.9
35	30.0	18.0	95	81.5	48.8	55	132.9	79.7	15	184.4	110.5	75	235.9	141.4
36	30.9	18.5	96	82.3	49.4	56	133.8	80.2	16	185.3	111.0	76	236.7	141.9
37	31.7	19.0	97	83.2	49.9	57	134.7	80.7	17	186.1	111.6	77	237.6	142.4
38	32.6	19.5	98	84.1	50.4	58	135.5	81.2	18	187.0	112.1	78	238.4	142.9
39	33.5	20.0	99	84.9	50.9	59	136.4	81.7	19	187.8	112.6	79	239.3	143.4
40	34.3	20.6	100	85.8	51.4	60	137.2	82.3	20	188.7	113.1	80	240.2	143.9
41	35.2	21.1	101	86.6	51.9	161	138.1	82.8	221	189.6	113.6	281	241.0	144.5
42	36.0	21.6	02	87.5	52.4	62	139.0	83.3	22	190.4	114.1	82	241.9	145.0
43	36.9	22.1	03	88.3	52.8	63	139.8	83.8	23	191.3	114.6	83	242.7	145.5
44	37.7	22.6	04	89.2	53.5	64	140.7	84.3	24	192.1	115.2	84	243.6	146.0
45	38.6	23.1	05	90.1	54.0	65	141.5	84.8	25	193.0	115.7	85	244.5	146.5
46	39.5	23.6	06	90.9	54.5	66	142.4	85.3	26	193.8	116.2	86	245.3	147.0
47	40.3	24.2	07	91.8	55.0	67	143.2	85.9	27	194.7	116.7	87	246.2	147.5
48	41.2	24.7	08	92.6	55.5	68	144.1	86.4	28	195.6	117.2	88	247.0	148.1
49	42.0	25.2	09	93.5	56.0	69	145.0	86.9	29	196.4	117.7	89	247.9	148.6
50	42.9	25.7	10	94.4	56.6	70	145.8	87.4	30	197.3	118.2	90	248.7	149.1
51	43.7	26.2	111	95.2	57.1	171	146.7	87.9	231	198.1	118.7	291	249.6	149.6
52	44.6	26.7	12	96.1	57.6	72	147.5	88.4	32	199.0	119.2	92	250.5	150.1
53	45.5	27.2	13	96.9	58.1	73	148.4	88.9	33	199.9	119.8	93	251.3	150.6
54	46.3	27.8	14	97.8	58.6	74	149.2	89.5	34	200.7	120.3	94	252.2	151.1
55	47.2	28.3	15	98.6	59.1	75	150.1	89.8	35	201.6	120.8	95	253.0	151.7
56	48.0	28.8	16	99.5	59.6	76	151.0	90.5	36	202.4	121.3	96	253.9	152.2
57	48.9	29.3	17	100.4	60.1	77	151.8	91.0	37	203.3	121.8	97	254.7	152.7
58	49.7	29.8	18	101.2	60.7	78	152.7	91.5	38	204.1	122.4	98	255.6	153.2
59	50.6	30.3	19	102.1	61.2	79	153.5	92.0	39	205.0	122.9	99	256.5	153.7
60	51.5	30.8	20	102.9	61.7	80	154.4	92.5	40	205.9	123.4	300	257.3	154.2
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 5 ¼ Points.

TABLE I. Difference of Latitude and Departure for 4 ½ Point.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	47.1	38.7	121	93.5	76.8	181	139.9	114.8	241	186.3	152.9
2	01.5	01.3	62	47.9	39.3	22	94.3	77.4	82	140.7	115.5	42	187.1	153.5
3	02.3	01.9	63	48.7	40.0	23	95.1	78.0	83	141.5	116.1	43	187.8	154.2
4	03.1	02.5	64	49.5	40.6	24	95.9	78.7	84	142.2	116.7	44	188.6	154.8
5	03.9	03.2	65	50.2	41.2	25	96.6	79.3	85	143.0	117.4	45	189.4	155.4
6	04.6	03.8	66	51.0	41.9	26	97.4	79.9	86	143.8	118.0	46	190.2	156.1
7	05.4	04.4	67	51.8	42.5	27	98.2	80.6	87	144.6	118.6	47	190.9	156.7
8	06.2	05.1	68	52.6	43.1	28	98.9	81.2	88	145.3	119.3	48	191.7	157.3
9	07.0	05.7	69	53.3	43.8	29	99.7	81.8	89	146.1	119.9	49	192.5	158.0
10	07.7	06.3	70	54.1	44.4	30	100.5	82.5	90	146.9	120.5	50	193.3	158.6
11	08.5	07.0	71	54.9	45.0	131	101.2	83.1	191	147.6	121.2	251	194.0	159.2
12	09.3	07.6	72	55.7	45.7	32	102.0	83.7	92	148.4	121.8	52	194.8	159.9
13	10.0	08.2	73	56.4	46.3	33	102.8	84.4	93	149.2	122.4	53	195.6	160.5
14	10.8	08.9	74	57.2	46.9	34	103.6	85.0	94	150.0	123.1	54	196.3	161.1
15	11.6	09.5	75	58.0	47.6	35	104.4	85.6	95	150.7	123.7	55	197.1	161.8
16	12.4	10.1	76	58.7	48.2	36	105.1	86.3	96	151.5	124.3	56	197.9	162.4
17	13.1	10.8	77	59.5	48.8	37	105.9	86.9	97	152.3	125.0	57	198.7	163.0
18	13.9	11.4	78	60.3	49.5	38	106.7	87.5	98	153.1	125.6	58	199.4	163.7
19	14.7	12.1	79	61.1	50.1	39	107.4	88.2	99	153.8	126.2	59	200.2	164.3
20	15.5	12.7	80	61.8	50.8	40	108.2	88.8	200	154.6	126.9	60	201.0	164.9
21	16.2	13.3	81	62.6	51.4	141	109.0	89.4	201	155.4	127.5	261	201.8	165.6
22	17.0	14.0	82	63.4	52.0	42	109.8	90.1	02	156.4	128.1	62	202.5	166.2
23	17.8	14.6	83	64.2	52.6	43	110.5	90.7	03	156.9	128.8	63	203.3	166.8
24	18.6	15.2	84	64.9	53.3	44	111.3	91.4	04	157.7	129.4	64	204.1	167.5
25	19.3	15.9	85	65.7	53.9	45	112.1	92.0	05	158.5	130.1	65	204.8	168.1
26	20.1	16.5	86	66.5	54.6	46	112.9	92.6	06	159.2	130.7	66	205.6	168.7
27	20.9	17.1	87	67.3	55.2	47	113.6	93.3	07	160.0	131.3	67	206.4	169.4
28	21.6	17.8	88	68.0	55.8	48	114.4	93.9	08	160.8	132.0	68	207.2	170.0
29	22.4	18.4	89	68.8	56.5	49	115.2	94.5	09	161.6	132.6	69	207.9	170.7
30	23.2	19.0	90	69.6	57.1	50	116.0	95.2	10	162.3	133.2	70	208.7	171.3
31	24.0	19.7	91	70.3	57.7	151	116.7	95.8	211	163.1	133.9	271	209.5	171.9
32	24.7	20.3	92	71.1	58.4	52	117.5	96.4	12	163.9	134.5	72	210.3	172.6
33	25.5	20.9	93	71.9	59.0	53	118.3	97.1	13	164.7	135.1	73	211.0	173.2
34	26.3	21.6	94	72.7	59.6	54	119.0	97.7	14	165.4	135.8	74	211.8	173.8
35	27.1	22.2	95	73.4	60.3	55	119.8	98.3	15	166.2	136.4	75	212.6	174.5
36	27.8	22.8	96	74.2	60.9	56	120.6	99.0	16	167.0	137.0	76	213.4	175.1
37	28.6	23.5	97	75.0	61.5	57	121.4	99.6	17	167.7	137.7	77	214.1	175.7
38	29.4	24.1	98	75.8	62.1	58	122.1	100.2	18	168.5	138.3	78	214.9	176.4
39	30.1	24.7	99	76.5	62.8	59	122.9	100.9	19	169.3	138.9	79	215.7	177.0
40	30.9	25.4	100	77.3	63.4	60	123.7	101.5	20	170.1	139.6	80	216.4	177.6
41	31.7	26.0	101	78.1	64.1	161	124.5	102.1	221	170.8	140.2	281	217.2	178.3
42	32.5	26.6	02	78.8	64.7	62	125.2	102.8	22	171.6	140.8	82	218.0	178.9
43	33.2	27.3	03	79.6	65.3	63	126.0	103.4	23	172.4	141.5	83	218.8	179.6
44	34.0	27.9	04	80.4	66.0	64	126.8	104.0	24	173.2	142.1	84	219.5	180.2
45	34.8	28.5	05	81.2	66.6	65	127.5	104.7	25	173.9	142.7	85	220.3	180.8
46	35.6	29.2	06	81.9	67.2	66	128.3	105.3	26	174.7	143.4	86	221.1	181.4
47	36.3	29.8	07	82.7	67.9	67	129.1	105.9	27	175.5	144.0	87	221.9	182.1
48	37.1	30.5	08	83.5	68.5	68	129.9	106.6	28	176.2	144.6	88	222.6	182.7
49	37.9	31.1	09	84.3	69.1	69	130.6	107.2	29	177.0	145.3	89	223.4	183.3
50	38.7	31.7	10	85.0	69.8	70	131.4	107.8	30	177.8	145.9	90	224.2	184.0
51	39.4	32.4	111	85.8	70.4	171	132.2	108.5	231	178.6	146.5	291	224.9	184.6
52	40.2	33.0	12	86.6	71.1	72	133.0	109.1	32	179.3	147.2	92	225.7	185.2
53	41.0	33.6	13	87.4	71.7	73	133.7	109.7	33	180.1	147.8	93	226.5	185.9
54	41.7	34.3	14	88.1	72.3	74	134.5	110.4	34	180.9	148.4	94	227.3	186.5
55	42.5	34.9	15	88.9	73.0	75	135.3	111.0	35	181.7	149.1	95	228.0	187.1
56	43.3	35.5	16	89.7	73.6	76	136.0	111.7	36	182.4	149.7	96	228.8	187.8
57	44.1	36.2	17	90.4	74.2	77	136.8	112.3	37	183.2	150.3	97	229.6	188.4
58	44.8	36.8	18	91.2	74.9	78	137.6	112.9	38	184.0	151.0	98	230.4	189.0
59	45.6	37.4	19	92.0	75.5	79	138.4	113.6	39	184.7	151.6	99	231.1	189.6
60	46.4	38.1	20	92.8	76.1	80	139.1	114.2	40	185.5	152.3	300	231.9	190.3
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 4 ½ Points.

Table I. Difference of Latitude and Departure for 3 ¼ Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	49.0	36.3	121	97.2	72.1	181	145.4	107.8	241	193.6	143.6
2	01.6	01.2	62	49.8	36.9	22	98.0	72.7	82	146.2	108.4	42	194.4	144.2
3	02.4	01.8	63	50.6	37.5	23	98.8	73.3	83	147.0	109.0	43	195.2	144.8
4	03.2	02.4	64	51.4	38.1	24	99.6	73.9	84	147.8	109.6	44	196.0	145.4
5	04.0	03.0	65	52.2	38.7	25	100.4	74.5	85	148.6	110.2	45	196.8	145.9
6	04.8	03.6	66	53.0	39.3	26	101.2	75.1	86	149.4	110.8	46	197.6	146.5
7	05.6	04.2	67	53.8	39.9	27	102.0	75.7	87	150.2	111.4	47	198.4	147.1
8	06.4	04.8	68	54.6	40.5	28	102.8	76.2	88	151.0	112.0	48	199.2	147.7
9	07.2	05.4	69	55.4	41.1	29	103.6	76.8	89	151.8	112.6	49	200.0	148.3
10	08.0	06.0	70	56.2	41.7	30	104.4	77.4	90	152.6	113.2	50	200.8	148.9
11	08.8	06.6	71	57.0	42.3	131	105.2	78.0	191	153.4	113.8	251	201.6	149.5
12	09.6	07.2	72	57.8	42.9	32	106.0	78.6	92	154.2	114.4	52	202.4	150.1
13	10.4	07.7	73	58.6	43.5	33	106.8	79.2	93	155.0	115.0	53	203.2	150.7
14	11.2	08.3	74	59.4	44.1	34	107.6	79.8	94	155.8	115.6	54	204.0	151.3
15	12.0	08.9	75	60.2	44.7	35	108.4	80.4	95	156.6	116.2	55	204.8	151.9
16	12.9	09.5	76	61.0	45.3	36	109.2	81.0	96	157.4	116.8	56	205.6	152.5
17	13.7	10.1	77	61.8	45.9	37	110.0	81.6	97	158.2	117.4	57	206.4	153.1
18	14.5	10.7	78	62.7	46.5	38	110.8	82.2	98	159.0	117.9	58	207.2	153.7
19	15.3	11.3	79	63.5	47.1	39	111.6	82.8	99	159.8	118.5	59	208.0	154.3
20	16.1	11.9	80	64.3	47.7	40	112.4	83.4	200	160.6	119.1	60	208.8	154.9
21	16.9	12.5	81	65.1	48.3	141	113.3	84.0	201	161.4	119.7	261	209.6	155.5
22	17.7	13.1	82	65.9	48.8	42	114.0	84.6	02	162.2	120.3	62	210.4	156.1
23	18.5	13.7	83	66.7	49.4	43	114.9	85.2	03	163.1	120.9	63	211.2	156.7
24	19.3	14.3	84	67.5	50.0	44	115.7	85.8	04	163.9	121.5	64	212.0	157.3
25	20.1	14.9	85	68.3	50.6	45	116.5	86.4	05	164.7	122.1	65	212.8	157.9
26	20.9	15.5	86	69.1	51.2	46	117.2	87.0	06	165.5	122.7	66	213.7	158.5
27	21.7	16.1	87	69.9	51.8	47	118.0	87.6	07	166.3	123.3	67	214.5	159.1
28	22.5	16.7	88	70.7	52.4	48	118.9	88.2	08	167.1	123.9	68	215.3	159.6
29	23.3	17.3	89	71.5	53.0	49	119.7	88.8	09	167.9	124.5	69	216.1	160.2
30	24.1	17.9	90	72.3	53.6	50	120.5	89.4	10	168.7	125.1	70	216.9	160.8
31	24.9	18.5	91	73.1	54.2	151	121.3	90.0	211	169.5	125.7	271	217.7	161.4
32	25.7	19.1	92	73.9	54.8	52	122.1	90.5	12	170.3	126.3	72	218.5	162.0
33	26.5	19.7	93	74.7	55.4	53	122.9	91.1	13	171.1	126.9	73	219.3	162.6
34	27.3	20.3	94	75.5	56.0	54	123.7	91.7	14	171.9	127.5	74	220.1	163.2
35	28.1	20.8	95	76.3	56.6	55	124.5	92.3	15	172.7	128.1	75	220.9	163.8
36	28.9	21.4	96	77.1	57.2	56	125.3	92.9	16	173.5	128.7	76	221.7	164.4
37	29.7	22.0	97	77.9	57.8	57	126.1	93.5	17	174.3	129.3	77	222.5	165.0
38	30.5	22.6	98	78.7	58.4	58	126.9	94.1	18	175.1	129.9	78	223.3	165.6
39	31.3	23.2	99	79.5	59.0	59	127.7	94.7	19	175.9	130.5	79	224.1	166.2
40	32.1	23.8	100	80.3	59.6	60	128.5	95.3	20	176.7	131.1	80	224.9	166.8
41	32.9	24.4	101	81.1	60.2	161	129.3	95.9	221	177.5	131.6	281	225.7	167.4
42	33.7	25.0	02	81.9	60.8	62	130.1	96.5	22	178.3	132.2	82	226.5	168.0
43	34.5	25.6	03	82.7	61.4	63	130.9	97.1	23	179.1	132.8	83	227.3	168.6
44	35.3	26.2	04	83.5	62.0	64	131.7	97.7	24	179.9	133.4	84	228.1	169.2
45	36.1	26.8	05	84.3	62.5	65	132.5	98.3	25	180.7	134.0	85	228.9	169.8
46	36.9	27.4	06	85.1	63.1	66	133.3	98.9	26	181.5	134.6	86	229.7	170.4
47	37.8	28.0	07	85.9	63.7	67	134.1	99.5	27	182.3	135.2	87	230.5	171.0
48	38.6	28.6	08	86.7	64.3	68	134.9	100.1	28	183.1	135.8	88	231.3	171.6
49	39.4	29.2	09	87.5	64.9	69	135.7	100.7	29	183.9	136.4	89	232.1	172.2
50	40.2	29.8	10	88.4	65.5	70	136.5	101.3	30	184.7	137.0	90	232.9	172.8
51	41.0	30.4	111	89.2	66.1	171	137.3	101.9	231	185.5	137.6	291	233.7	173.3
52	41.8	31.0	12	90.0	66.7	72	138.2	102.5	32	186.3	138.2	92	234.5	173.9
53	42.6	31.6	13	90.8	67.3	73	139.0	103.1	33	187.1	138.8	93	235.3	174.5
54	43.4	32.2	14	91.6	67.9	74	139.8	103.7	34	188.0	139.4	94	236.1	175.1
55	44.2	32.8	15	92.4	68.5	75	140.6	104.2	35	188.8	140.0	95	236.9	175.7
56	45.0	33.4	16	93.2	69.1	76	141.4	104.8	36	189.6	140.6	96	237.7	176.3
57	45.8	34.0	17	94.0	69.7	77	142.2	105.4	37	190.4	141.2	97	238.6	176.9
58	46.6	34.6	18	94.8	70.3	78	143.0	106.0	38	191.2	141.8	98	239.4	177.5
59	47.4	35.1	19	95.6	70.9	79	143.8	106.6	39	192.0	142.4	99	240.2	178.1
60	48.2	35.7	20	96.4	71.5	80	144.6	107.2	40	192.8	143.0	300	241.0	178.7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 4 ¾ Points.

TABLE I. Difference of Latitude and Departure for 4 Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.7	00.7	61	43.1	43.1	121	85.6	85.6	181	128.0	128.0	241	170.4	170.4
2	01.4	01.4	62	43.8	43.8	22	86.3	86.3	82	128.7	128.7	42	171.1	171.1
3	02.1	02.1	63	44.5	44.5	23	87.0	87.0	83	129.4	129.4	43	171.8	171.8
4	02.8	02.8	64	45.3	45.3	24	87.7	87.7	84	130.1	130.1	44	172.5	172.5
5	03.5	03.5	65	46.0	46.0	25	88.4	88.4	85	130.8	130.8	45	173.2	173.2
6	04.2	04.2	66	46.7	46.7	26	89.1	89.1	86	131.5	131.5	46	173.9	173.9
7	04.9	04.9	67	47.4	47.4	27	89.8	89.8	87	132.2	132.2	47	174.7	174.7
8	05.7	05.7	68	48.1	48.1	28	90.5	90.5	88	132.9	132.9	48	175.4	175.4
9	06.4	06.4	69	48.8	48.8	29	91.2	91.2	89	133.6	133.6	49	176.1	176.1
10	07.1	07.1	70	49.5	49.5	30	91.9	91.9	90	134.4	134.4	50	176.8	176.8
11	07.8	07.8	71	50.2	50.2	131	92.6	92.6	191	135.1	135.1	251	177.5	177.5
12	08.5	08.5	72	50.9	50.9	32	93.3	93.3	92	135.8	135.8	52	178.2	178.2
13	09.2	09.2	73	51.6	51.6	33	94.0	94.0	93	136.5	136.5	53	178.9	178.9
14	09.9	09.9	74	52.3	52.3	34	94.8	94.8	94	137.2	137.2	54	179.6	179.6
15	10.6	10.6	75	53.0	53.0	35	95.5	95.5	95	137.9	137.9	55	180.3	180.3
16	11.3	11.3	76	53.7	53.7	36	96.2	96.2	96	138.6	138.6	56	181.0	181.0
17	12.0	12.0	77	54.4	54.4	37	96.9	96.9	97	139.3	139.3	57	181.7	181.7
18	12.7	12.7	78	55.2	55.2	38	97.6	97.6	98	140.0	140.0	58	182.4	182.4
19	13.4	13.4	79	55.9	55.9	39	98.3	98.3	99	140.7	140.7	59	183.1	183.1
20	14.1	14.1	80	56.6	56.6	40	99.0	99.0	200	141.4	141.4	60	183.8	183.8
21	14.8	14.8	81	57.3	57.3	141	99.7	99.7	201	142.1	142.1	261	184.6	184.6
22	15.6	15.6	82	58.0	58.0	42	100.4	100.4	02	142.8	142.8	62	185.3	185.3
23	16.3	16.3	83	58.7	58.7	43	101.1	101.1	03	143.5	143.5	63	186.0	186.0
24	17.0	17.0	84	59.4	59.4	44	101.8	101.8	04	144.2	144.2	64	186.7	186.7
25	17.7	17.7	85	60.1	60.1	45	102.5	102.5	05	145.0	145.0	65	187.4	187.4
26	18.4	18.4	86	60.8	60.8	46	103.2	103.2	06	145.7	145.7	66	188.1	188.1
27	19.1	19.1	87	61.5	61.5	47	103.9	103.9	07	146.4	146.4	67	188.8	188.8
28	19.8	19.8	88	62.2	62.2	48	104.7	104.7	08	147.1	147.1	68	189.5	189.5
29	20.5	20.5	89	62.9	62.9	49	105.4	105.4	09	147.8	147.8	69	190.2	190.2
30	21.2	21.2	90	63.6	63.6	50	106.1	106.1	10	148.5	148.5	70	190.9	190.9
31	21.9	21.9	91	64.3	64.3	151	106.8	106.8	211	149.2	149.2	271	191.6	191.6
32	22.6	22.6	92	65.1	65.1	52	107.5	107.5	12	149.9	149.9	72	192.3	192.3
33	23.3	23.3	93	65.8	65.8	53	108.2	108.2	13	150.6	150.6	73	193.0	193.0
34	24.0	24.0	94	66.5	66.5	54	108.9	108.9	14	151.3	151.3	74	193.7	193.7
35	24.7	24.7	95	67.2	67.2	55	109.6	109.6	15	152.0	152.0	75	194.5	194.5
36	25.5	25.5	96	67.9	67.9	56	110.3	110.3	16	152.7	152.7	76	195.2	195.2
37	26.2	26.2	97	68.6	68.6	57	111.0	111.0	17	153.4	153.4	77	195.9	195.9
38	26.9	26.9	98	69.3	69.3	58	111.7	111.7	18	154.1	154.1	78	196.6	196.6
39	27.6	27.6	99	70.0	70.0	59	112.4	112.4	19	154.9	154.9	79	197.3	197.3
40	28.3	28.3	100	70.7	70.7	60	113.1	113.1	20	155.6	155.6	80	198.0	198.0
41	29.0	29.0	101	71.4	71.4	161	113.8	113.8	221	156.3	156.3	281	198.7	198.7
42	29.7	29.7	02	72.1	72.1	62	114.6	114.6	22	157.0	157.0	82	199.4	199.4
43	30.4	30.4	03	72.8	72.8	63	115.3	115.3	23	157.7	157.7	83	200.1	200.1
44	31.1	31.1	04	73.5	73.5	64	116.0	116.0	24	158.4	158.4	84	200.8	200.8
45	31.8	31.8	05	74.2	74.2	65	116.7	116.7	25	159.1	159.1	85	201.5	201.5
46	32.5	32.5	06	75.0	75.0	66	117.4	117.4	26	159.8	159.8	86	202.2	202.2
47	33.2	33.2	07	75.7	75.7	67	118.1	118.1	27	160.5	160.5	87	202.9	202.9
48	33.9	33.9	08	76.4	76.4	68	118.8	118.8	28	161.2	161.2	88	203.6	203.6
49	34.6	34.6	09	77.1	77.1	69	119.5	119.5	29	161.9	161.9	89	204.4	204.4
50	35.4	35.4	10	77.8	77.8	70	120.2	120.2	30	162.6	162.6	90	205.1	205.1
51	36.1	36.1	111	78.5	78.5	171	120.9	120.9	231	163.3	163.3	291	205.8	205.8
52	36.8	36.8	12	79.2	79.2	72	121.6	121.6	32	164.0	164.0	92	206.5	206.5
53	37.5	37.5	13	79.9	79.9	73	122.3	122.3	33	164.8	164.8	93	207.2	207.2
54	38.2	38.2	14	80.6	80.6	74	123.0	123.0	34	165.5	165.5	94	207.9	207.9
55	38.9	38.9	15	81.3	81.3	75	123.7	123.7	35	166.2	166.2	95	208.6	208.6
56	39.6	39.6	16	82.0	82.0	76	124.5	124.5	36	166.9	166.9	96	209.3	209.3
57	40.3	40.3	17	82.7	82.7	77	125.2	125.2	37	167.6	167.6	97	210.0	210.0
58	41.0	41.0	18	83.4	83.4	78	125.9	125.9	38	168.3	168.3	98	210.7	210.7
59	41.7	41.7	19	84.1	84.1	79	126.6	126.6	39	169.0	169.0	99	211.4	211.4
60	42.4	42.4	20	84.9	84.9	80	127.3	127.3	40	169.7	169.7	300	212.1	212.1
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 4 Points.

Table I. Difference of Latitude and Departure for 3 ¾ Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.7	00.7	61	45.2	41.0	121	89.7	81.3	181	134.1	121.6	141	178.6	161.8
2	01.5	01.3	62	45.9	41.6	22	90.4	81.9	82	134.9	122.2	42	179.3	162.5
3	02.2	02.0	63	46.7	42.3	23	91.1	82.6	83	135.6	122.9	43	180.1	163.2
4	03.0	02.7	64	47.4	43.0	24	91.9	83.3	84	136.3	123.6	44	180.8	163.9
5	03.7	03.4	65	48.2	43.7	25	92.6	83.9	85	137.1	124.2	45	181.5	164.5
6	04.4	04.0	66	48.9	44.3	26	93.4	84.6	86	137.8	124.9	46	182.3	165.2
7	05.2	04.7	67	49.6	45.0	27	94.1	85.3	87	138.6	125.6	47	183.0	165.9
8	05.9	05.4	68	50.4	45.7	28	94.8	86.0	88	139.3	126.3	48	183.8	166.5
9	06.7	06.0	69	51.1	46.3	29	95.6	86.6	89	140.0	126.9	49	184.5	167.2
10	07.4	06.7	70	51.9	47.0	30	96.3	87.3	90	140.7	127.6	50	185.2	167.9
11	08.2	07.4	71	52.6	47.7	131	97.1	88.0	191	141.5	128.3	251	186.0	168.6
12	08.9	08.1	72	53.3	48.4	32	97.8	88.6	92	142.3	128.9	52	186.7	169.2
13	09.6	08.7	73	54.1	49.0	33	98.5	89.3	93	143.0	129.6	53	187.5	169.9
14	10.4	09.4	74	54.8	49.7	34	99.3	90.0	94	143.7	130.3	54	188.2	170.6
15	11.1	10.1	75	55.6	50.4	35	100.0	90.7	95	144.5	131.0	55	188.9	171.2
16	11.9	10.7	76	56.3	51.0	36	100.8	91.3	96	145.2	131.6	56	189.7	171.9
17	12.6	11.4	77	57.1	51.7	37	101.5	92.0	97	146.0	132.3	57	190.4	172.6
18	13.3	12.1	78	57.8	52.4	38	102.3	92.7	98	146.7	133.0	58	191.2	173.3
19	14.1	12.8	79	58.5	53.1	39	103.0	93.3	99	147.4	133.6	59	191.9	173.9
20	14.8	13.4	80	59.3	53.7	40	103.7	94.0	200	148.2	134.3	60	192.6	174.6
21	15.6	14.1	81	60.0	54.4	141	104.5	94.7	201	148.9	135.0	261	193.4	175.3
22	16.3	14.8	82	60.8	55.1	42	105.2	95.4	02	149.7	135.7	62	194.1	175.9
23	17.0	15.4	83	61.5	55.7	43	106.0	96.0	03	150.4	136.3	63	194.9	176.6
24	17.8	16.1	84	62.2	56.4	44	106.7	96.7	04	151.2	137.0	64	195.6	177.3
25	18.5	16.8	85	63.0	57.1	45	107.4	97.4	05	151.9	137.7	65	196.4	178.0
26	19.3	17.5	86	63.7	97.8	46	108.2	98.0	06	152.6	138.3	66	197.1	178.6
27	20.0	18.1	87	64.5	58.4	47	108.9	98.7	07	153.4	139.0	67	197.8	179.3
28	20.7	18.8	88	65.2	59.1	48	109.8	99.4	08	154.1	139.7	68	198.6	180.0
29	21.5	19.5	89	65.9	59.8	49	110.4	100.1	09	154.9	140.4	69	199.3	180.6
30	22.2	20.1	90	66.7	60.4	50	111.1	100.7	10	155.6	141.0	70	200.1	181.3
31	23.0	20.8	91	67.4	61.1	151	111.9	101.4	211	156.3	141.7	271	200.8	182.0
32	23.7	21.5	92	68.2	61.8	12	112.6	102.1	12	157.1	142.4	72	201.5	182.7
33	24.4	22.2	93	68.9	62.5	53	113.4	102.7	13	157.8	143.0	73	202.3	183.3
34	25.2	22.8	94	69.6	63.1	54	114.1	103.4	14	158.6	143.7	74	203.0	184.0
35	25.9	23.5	95	70.4	63.8	55	114.8	104.1	15	159.3	144.4	75	203.8	184.7
36	26.7	24.2	96	71.1	64.5	56	115.6	104.8	16	160.0	145.1	76	204.5	185.4
37	27.4	24.8	97	71.9	65.1	57	116.3	105.4	17	160.8	145.7	77	205.2	186.0
38	28.2	25.5	98	72.6	65.8	58	117.1	106.1	18	161.5	146.4	78	206.0	186.7
39	28.9	26.2	99	73.4	66.5	59	117.8	106.8	19	162.3	147.1	79	206.7	187.4
40	29.6	26.9	100	74.1	67.2	60	118.6	107.4	20	163.0	147.7	80	207.5	188.0
41	30.4	27.5	101	74.8	67.8	161	119.3	108.1	221	163.8	148.4	281	208.2	188.7
42	31.1	28.2	02	75.6	68.5	62	120.0	108.8	22	164.5	149.1	82	208.9	189.4
43	31.9	28.9	03	76.3	69.2	63	120.8	109.5	23	165.2	149.8	83	209.7	190.1
44	32.6	29.5	04	77.1	69.8	64	121.5	110.1	24	166.0	150.4	84	210.4	190.7
45	33.3	30.2	05	77.8	70.5	65	122.3	110.8	25	166.7	151.1	85	211.2	191.4
46	34.1	30.9	06	78.5	71.2	66	123.0	111.5	26	167.5	151.8	86	211.9	192.1
47	34.8	31.6	07	79.3	71.9	67	123.7	112.2	27	168.2	152.4	87	212.7	192.7
48	35.6	32.2	08	80.0	72.5	68	124.5	112.8	28	168.9	153.1	88	213.4	193.4
49	36.3	32.9	09	80.8	73.2	69	125.2	113.5	29	169.7	153.8	89	214.1	194.1
50	37.0	33.6	10	81.5	73.9	70	126.0	114.2	30	170.4	154.5	90	214.9	194.8
51	37.8	34.2	111	82.2	74.5	171	126.7	114.8	231	171.2	155.1	291	215.6	195.4
52	38.5	34.9	12	83.0	75.2	72	127.4	115.5	32	171.9	155.8	92	216.4	196.1
53	39.3	35.6	13	83.7	75.9	73	128.2	116.2	33	172.6	156.5	93	217.1	196.8
54	40.0	36.3	14	84.5	76.6	74	128.9	116.9	34	173.4	157.1	94	217.8	197.4
55	40.8	36.9	15	85.2	77.2	75	129.7	117.5	35	174.1	157.8	95	218.6	198.1
56	41.5	37.6	16	86.0	77.9	76	130.4	118.2	36	174.9	158.5	96	219.3	198.8
57	42.2	38.3	17	86.7	78.6	77	131.1	118.9	37	175.6	159.2	97	220.1	199.5
58	43.0	39.0	18	87.4	79.2	78	131.9	119.5	38	176.3	159.8	98	220.9	200.1
59	43.7	39.6	19	88.2	79.9	79	132.6	120.2	39	177.1	160.5	99	221.5	200.8
60	44.5	40.3	20	88.9	80.6	80	133.4	120.9	40	177.8	161.2	300	222.3	201.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 4 ¼ Points

TABLE II. Difference of Latitude and Departure for 2 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.0	61	61.0	02.1	121	120.9	04.2	181	180.9	06.3	241	240.9	08.4
2	02.0	00.1	62	62.0	02.2	22	121.9	04.3	82	181.9	06.4	42	241.9	08.4
3	03.0	00.1	63	63.0	02.2	23	122.9	04.3	83	182.9	06.4	43	242.9	08.5
4	04.0	00.1	64	64.0	02.2	24	123.9	04.3	84	183.9	06.4	44	243.9	08.5
5	05.0	00.2	65	65.0	02.3	25	124.9	04.4	85	184.9	06.5	45	244.9	08.6
6	06.0	00.2	66	66.0	02.3	26	125.9	04.4	86	185.9	06.5	46	245.9	08.6
7	07.0	00.2	67	67.0	02.3	27	126.9	04.4	87	186.9	06.5	47	246.8	08.6
8	08.0	00.3	68	68.0	02.4	28	127.9	04.5	88	187.9	06.6	48	247.8	08.7
9	09.0	00.3	69	69.0	02.4	29	128.9	04.5	89	188.9	06.6	49	248.8	08.7
10	10.0	00.3	70	70.0	02.4	30	129.9	04.5	90	189.9	06.6	50	249.8	08.7
11	11.0	00.4	71	71.0	02.5	131	130.9	04.6	191	190.9	06.7	251	250.8	08.8
12	12.0	00.4	72	72.0	02.5	32	131.9	04.6	92	191.9	06.7	52	251.8	08.8
13	13.0	00.5	73	73.0	02.5	33	132.9	04.6	93	192.9	06.7	53	252.8	08.8
14	14.0	00.5	74	74.0	02.6	34	133.9	04.7	94	193.9	06.8	54	253.8	08.9
15	15.0	00.5	75	75.0	02.6	35	134.9	04.7	95	194.9	06.8	55	254.8	08.9
16	16.0	00.6	76	76.0	02.7	36	135.9	04.8	96	195.9	06.8	56	255.8	08.9
17	17.0	00.6	77	77.0	02.7	37	136.9	04.8	97	196.9	06.9	57	256.8	09.0
18	18.0	00.6	78	78.0	02.7	38	137.9	04.8	98	197.9	06.9	58	257.8	09.0
19	19.0	00.7	79	79.0	02.8	39	138.9	04.9	99	198.9	06.9	59	258.8	09.0
20	20.0	00.7	80	80.0	02.8	40	139.9	04.9	200	199.9	07.0	60	259.8	09.1
21	21.0	00.7	81	81.0	02.8	141	140.9	04.9	201	200.9	07.0	261	260.8	09.1
22	22.0	00.8	82	82.0	02.9	42	141.9	05.0	02	201.9	07.0	62	261.8	09.1
23	23.0	00.8	83	82.9	02.9	43	142.9	05.0	03	202.9	07.1	63	262.8	09.2
24	24.0	00.8	84	83.9	02.9	44	143.9	05.0	04	203.9	07.1	64	263.8	09.2
25	25.0	00.9	85	84.9	03.0	45	144.9	05.1	05	204.9	07.2	65	264.8	09.2
26	26.0	00.9	86	85.9	03.0	46	145.9	05.1	06	205.9	07.2	66	265.8	09.3
27	27.0	00.9	87	86.9	03.0	47	146.9	05.1	07	206.9	07.2	67	266.8	09.3
28	28.0	01.0	88	87.9	03.1	48	147.9	05.2	08	207.9	07.3	68	267.8	09.4
29	29.0	01.0	89	88.9	03.1	49	148.9	05.2	09	208.9	07.3	69	268.8	09.4
30	30.0	01.0	90	89.9	03.1	50	149.9	05.2	10	209.9	07.3	70	269.8	09.4
31	31.0	01.1	91	90.9	03.2	151	150.9	05.3	211	210.9	07.4	271	270.8	09.5
32	32.0	01.1	92	91.9	03.2	52	151.9	05.3	12	211.9	07.4	72	271.8	09.5
33	33.0	01.2	93	92.9	03.2	53	152.9	05.3	13	212.9	07.4	73	272.8	09.5
34	34.0	01.2	94	93.9	03.3	54	153.9	05.4	14	213.9	07.	74	273.8	09.6
35	35.0	01.2	95	94.9	03.3	55	154.9	05.4	15	214.9	07.5	75	274.8	09.6
36	36.0	01.3	96	95.9	03.4	56	155.9	05.4	16	215.9	07.5	76	275.8	09.6
37	37.0	01.3	97	96.9	03.4	57	156.9	05.5	17	216.9	07.6	77	276.8	09.7
38	38.0	01.3	98	97.9	03.4	58	157.9	05.5	18	217.9	07.6	78	277.8	09.7
39	39.0	01.4	99	98.9	03.5	59	158.9	05.5	19	218.9	07.6	79	278.8	09.7
40	40.0	01.4	100	99.9	03.5	60	159.9	05.6	20	219.9	07.7	80	279.8	09.8
41	41.0	01.4	101	100.9	03.5	161	160.9	05.6	221	220.9	07.7	281	280.8	09.8
42	42.0	01.5	02	101.9	03.6	62	161.9	05.7	22	221.9	07.7	82	281.8	09.8
43	43.0	01.5	03	102.9	03.6	63	162.9	05.7	23	222.9	07.8	83	282.8	09.9
44	44.0	01.5	04	103.9	03.6	64	163.9	05.7	24	223.9	07.8	84	283.8	09.9
45	45.0	01.6	05	104.9	03.7	65	164.9	05.8	25	224.9	07.9	85	284.8	09.9
46	46.0	01.6	06	105.9	03.7	66	165.9	05.8	26	225.9	07.9	86	285.8	10.0
47	47.0	01.6	07	106.9	03.7	67	166.9	05.8	27	226.9	07.9	87	286.8	10.0
48	48.0	01.7	08	107.9	03.8	68	167.9	05.9	28	227.9	08.0	88	287.8	10.1
49	49.0	01.7	09	108.9	03.8	69	168.9	05.9	29	228.9	08.0	89	288.8	10.1
50	50.0	01.7	10	109.9	03.8	70	169.9	05.9	30	229.9	08.0	90	289.8	10.1
51	51.0	01.8	111	110.9	03.9	171	170.9	06.0	231	230.9	08.1	291	290.8	10.2
52	52.0	01.8	12	111.9	03.9	72	171.9	06.0	32	231.9	08.1	92	291.8	10.2
53	53.0	01.8	13	112.9	03.9	73	172.9	06.0	33	232.9	08.1	93	292.8	10.2
54	54.0	01.9	14	113.9	04.0	74	173.9	06.1	34	233.9	08.2	94	293.8	10.3
55	55.0	01.9	15	114.9	04.0	75	174.9	06.1	35	234.9	08.2	95	294.8	10.3
56	56.0	02.0	16	115.9	04.0	76	175.9	06.1	36	235.9	08.2	96	295.8	10.3
57	57.0	02.0	17	116.9	04.1	77	176.9	06.2	37	236.9	08.3	97	296.8	10.4
58	58.0	02.0	18	117.9	04.1	78	177.9	06.2	38	237.9	08.3	98	297.8	10.4
59	59.0	02.1	19	118.9	04.2	79	178.9	06.2	39	238.9	08.3	99	298.8	10.4
60	60.0	02.1	20	119.9	04.2	80	179.9	06.3	40	239.9	08.4	300	299.8	10.4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 88 Degrees.

Table II. Difference of Latitude and Departure for 1 Degree.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.0	61	61.0	01.1	121	121.0	02.1	181	181.0	03.2	241	241.0	04.2
2	02.0	00.0	62	62.0	01.1	22	122.0	02.1	82	182.0	03.2	42	242.0	04.2
3	03.0	00.1	63	63.0	01.1	23	123.0	02.1	83	183.0	03.2	43	243.0	04.2
4	04.0	00.1	64	64.0	01.1	24	124.0	02.2	84	184.0	03.2	44	244.0	04.3
5	05.0	00.1	65	65.0	01.1	25	125.0	02.2	85	185.0	03.2	45	245.0	04.3
6	06.0	00.1	66	66.0	01.2	26	126.0	02.2	86	186.0	03.2	46	246.0	04.3
7	07.0	00.1	67	67.0	01.2	27	127.0	02.2	87	187.0	03.3	47	247.0	04.3
8	08.0	00.1	68	68.0	01.2	28	128.0	02.2	88	188.0	03.3	48	248.0	04.3
9	09.0	00.2	69	69.0	01.2	29	129.0	02.2	89	189.0	03.3	49	249.0	04.3
10	10.0	00.2	70	70.0	01.2	30	130.0	02.3	90	190.0	03.3	50	250.0	04.4
11	11.0	00.2	71	71.0	01.2	131	131.0	02.3	191	191.0	03.3	251	251.0	04.4
12	12.0	00.2	72	72.0	01.3	32	132.0	02.3	92	192.0	03.4	52	252.0	04.4
13	13.0	00.2	73	73.0	01.3	33	133.0	02.3	93	193.0	03.4	53	253.0	04.4
14	14.0	00.2	74	74.0	01.3	34	134.0	02.3	94	194.0	03.4	54	254.0	04.4
15	15.0	00.3	75	75.0	01.3	35	135.0	02.3	95	195.0	03.4	55	255.0	04.5
16	16.0	00.3	76	76.0	01.3	36	136.0	02.4	96	196.0	03.4	56	256.0	04.5
17	17.0	00.3	77	77.0	01.3	37	137.0	02.4	97	197.0	03.4	57	257.0	04.5
18	18.0	00.3	78	78.0	01.4	38	138.0	02.4	98	198.0	03.5	58	258.0	04.5
19	19.0	00.3	79	79.0	01.4	39	139.0	02.4	99	199.0	03.5	59	259.0	04.5
20	20.9	00.3	80	80.0	01.4	40	140.0	02.4	200	200.0	03.5	60	260.0	04.5
21	21.0	00.4	81	81.0	01.4	141	141.0	02.5	201	201.0	03.5	261	261.0	04.6
22	22.0	00.4	82	82.0	01.4	42	142.0	02.5	02	202.0	03.5	62	262.0	04.6
23	23.0	00.4	83	83.0	01.5	43	143.0	02.5	03	203.0	03.5	63	263.0	04.6
24	24.9	00.4	84	84.0	01.5	44	144.0	02.5	04	204.0	03.6	64	264.0	04.6
25	25.0	00.4	85	85.0	01.5	45	145.0	02.5	05	205.0	03.6	65	265.0	04.6
26	26.0	00.5	86	86.0	01.5	46	146.0	02.5	06	206.0	03.6	66	266.0	04.6
27	27.0	00.5	87	87.0	01.5	47	147.0	02.6	07	207.0	03.6	67	267.0	04.7
28	28.0	00.5	88	88.0	01.5	48	148.0	02.6	08	208.0	03.6	68	268.0	04.7
29	29.0	00.5	89	89.0	01.6	49	149.0	02.6	09	209.0	03.6	69	269.0	04.7
30	30.0	00.5	90	90.0	01.6	50	150.0	02.6	10	210.0	03.7	70	270.0	04.7
31	31.0	00.5	91	91.0	01.6	151	151.0	02.6	211	211.0	03.7	271	271.0	04.7
32	32.0	00.6	92	92.0	01.6	52	152.0	02.7	12	212.0	03.7	72	272.0	04.7
33	33.0	00.6	93	93.0	01.6	53	153.0	02.7	13	213.0	03.7	73	273.0	04.8
34	34.0	00.6	94	94.0	01.6	54	154.0	02.7	14	214.0	23.7	74	274.0	04.8
35	35.0	00.6	95	95.0	01.7	55	155.0	02.7	15	215.0	03.8	75	275.0	04.8
36	36.0	00.6	96	96.0	01.7	56	156.0	02.7	16	216.0	03.8	76	276.0	04.8
37	37.0	00.6	97	97.0	01.7	57	157.0	02.7	17	217.0	03.8	77	177.0	04.8
38	38.0	00.7	98	98.0	01.7	58	158.0	02.8	18	218.0	03.8	78	278.0	04.9
39	39.0	00.7	99	99.0	01.7	59	159.0	02.8	19	219.0	03.8	79	279.0	04.9
40	40.0	00.7	100	100.0	01.7	60	160.0	02.8	20	220.0	03.8	80	280.0	04.9
41	41.0	00.7	101	101.0	01.8	161	161.0	02.8	221	221.0	03.9	281	281.0	04.9
42	42.0	00.7	02	102.0	01.8	62	162.0	02.8	22	222.0	03.9	82	282.0	04.9
43	43.0	00.8	03	103.0	01.8	63	163.0	02.8	23	223.0	03.9	83	283.0	04.9
44	44.0	00.8	04	104.0	01.8	64	164.0	02.9	24	224.0	03.9	84	284.0	05.0
45	45.0	00.8	05	105.0	01.8	65	165.0	02.9	25	225.0	03.9	85	285.0	05.0
46	46.0	00.8	06	106.0	01.8	66	166.0	02.9	26	226.0	03.9	86	286.0	05.0
47	47.0	00.8	07	107.0	01.9	67	167.0	01.9	27	227.0	04.0	87	287.0	05.0
48	48.0	00.8	08	108.0	01.9	68	168.0	02.9	28	228.0	04.0	88	288.0	25.0
49	49.0	00.9	09	109.0	01.9	69	169.0	02.9	29	229.0	04.0	89	289.0	05.0
50	50.0	00.9	10	110.0	01.9	70	170.0	03.0	30	230.0	04.0	90	290.0	05.1
51	51.0	00.9	111	111.0	01.9	171	171.0	03.0	231	231.0	04.0	291	291.0	05.1
52	52.0	00.9	12	112.0	01.9	72	172.0	03.0	32	232.0	04.0	92	292.0	05.1
53	53.0	00.9	13	113.0	02.0	73	173.0	03.0	33	233.0	04.1	93	293.0	05.1
54	54.0	00.9	14	114.0	02.0	74	174.0	03.0	34	234.0	04.1	94	294.0	05.1
55	55.0	01.0	15	115.0	02.0	75	175.0	03.0	35	235.0	04.1	95	295.0	05.1
56	56.0	01.0	16	116.0	02.0	76	176.0	03.1	36	236.0	04.1	96	296.0	05.2
57	57.0	01.0	17	117.0	02.0	77	177.0	03.1	37	237.0	04.1	97	297.0	05.2
58	58.0	01.0	18	118.0	02.1	78	178.0	03.1	38	238.0	04.2	98	298.0	05.2
59	59.0	01.0	19	119.0	02.1	79	179.0	03.1	39	239.0	04.2	99	299.0	05.2
60	60.0	01.1	20	120.0	02.1	80	180.0	03.1	40	240.0	04.2	300	300.0	05.2
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 89 Degrees.

TABLE II. Difference of Latitude and Departure for 4 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.1	61	60.9	04.3	121	120.7	08.4	181	180.6	12.6	241	240.4	16.8
2	02.0	00.1	62	61.8	04.3	22	121.7	08.5	82	181.6	12.7	42	241.4	16.9
3	03.0	00.2	63	62.8	04.4	23	122.7	08.6	83	182.6	12.8	43	242.4	17.0
4	04.0	00.3	64	63.8	04.5	24	123.7	08.6	84	183.6	12.8	44	243.4	17.0
5	05.0	00.3	65	64.8	04.5	25	124.7	08.7	85	184.6	12.9	45	244.4	17.1
6	06.0	00.4	66	65.8	04.6	26	125.7	08.8	86	185.5	13.0	46	245.4	17.2
7	07.0	00.5	67	66.8	04.7	27	126.7	08.9	87	186.5	13.0	47	246.4	17.2
8	08.0	00.6	68	67.8	04.7	28	127.7	08.9	88	187.5	13.1	48	247.4	17.3
9	09.0	00.6	69	68.8	04.8	29	128.7	09.0	89	188.5	13.2	49	248.4	17.4
10	10.0	00.7	70	69.8	04.9	30	129.7	09.1	90	189.5	13.3	50	249.4	17.4
11	11.0	00.8	71	70.8	05.0	131	130.7	09.1	191	190.5	13.3	251	250.4	17.5
12	12.0	00.8	72	71.8	05.0	32	131.7	09.2	92	191.5	13.4	52	251.4	17.6
13	13.0	00.9	73	72.8	05.1	33	132.7	09.3	93	192.5	13.5	53	252.4	17.6
14	14.0	01.0	74	73.8	05.2	34	133.7	09.3	94	193.5	13.5	54	253.4	17.7
15	15.0	01.0	75	74.8	05.2	35	134.7	09.4	95	194.5	13.6	55	254.4	17.8
16	16.0	01.1	76	75.8	05.3	36	135.7	09.5	96	195.5	13.7	56	255.4	17.9
17	17.0	01.2	77	76.8	05.4	37	136.7	09.6	97	196.5	13.7	57	256.4	17.9
18	18.0	01.3	78	77.8	05.4	38	137.7	09.6	98	197.5	13.8	58	257.4	18.0
19	19.0	01.3	79	78.8	05.5	39	138.7	09.7	99	198.5	13.9	59	258.4	18.1
20	20.0	01.4	80	79.8	05.6	40	139.7	09.8	200	199.5	14.0	60	259.4	18.1
21	20.9	01.5	81	80.8	05.7	141	140.7	09.8	201	200.5	14.0	261	260.4	18.2
22	21.9	01.5	82	81.8	05.7	42	141.7	09.9	02	201.5	14.1	62	261.4	18.3
23	22.9	01.6	83	82.8	05.8	43	142.7	10.0	03	202.5	14.2	63	262.4	18.3
24	23.9	01.7	84	83.8	05.9	44	143.6	10.0	04	203.5	14.2	64	263.4	18.4
25	24.9	01.7	85	84.8	05.9	45	144.6	10.1	05	204.5	14.3	65	264.4	18.5
26	25.9	01.8	86	85.8	06.0	46	145.6	10.2	06	205.5	14.4	66	265.4	18.6
27	26.9	01.9	87	86.8	06.1	47	146.6	10.3	07	206.5	14.4	67	266.3	18.6
28	27.9	02.0	88	87.8	06.1	48	147.6	10.3	08	207.5	14.5	68	267.3	18.7
29	28.9	02.0	89	88.8	06.2	49	148.6	10.4	09	208.5	14.6	69	268.3	18.8
30	29.9	02.1	90	89.8	06.3	50	149.6	10.5	10	209.5	14.6	70	269.3	18.8
31	30.9	02.2	91	90.8	06.3	151	150.6	10.5	211	210.5	14.7	271	270.3	18.9
32	31.9	02.2	92	91.8	06.4	52	151.6	10.6	12	211.5	14.8	72	271.3	19.0
33	32.9	02.3	93	92.8	06.5	53	152.6	10.7	13	212.5	14.9	73	072.3	19.0
34	33.9	02.4	94	93.8	06.6	54	153.6	10.7	14	213.5	14.9	74	273.3	19.1
35	34.9	02.4	95	94.8	06.6	55	154.6	10.8	15	214.5	15.0	75	274.3	19.2
36	35.9	02.5	96	95.8	06.7	56	155.6	10.9	16	215.5	15.1	76	275.3	19.2
37	36.9	02.6	97	96.8	06.8	57	156.6	11.0	17	216.5	15.1	77	276.3	19.3
38	37.9	02.7	98	97.8	06.8	58	157.6	11.0	18	217.5	15.2	78	277.3	19.4
39	38.9	02.7	99	98.8	06.9	59	158.6	11.1	19	218.5	15.3	79	278.3	19.5
40	39.9	02.8	100	99.8	07.0	60	159.6	11.2	20	219.5	15.3	80	279.3	19.5
41	40.9	02.9	101	100.8	07.0	161	160.6	11.2	221	220.5	15.4	281	280.3	19.6
42	41.9	02.9	02	101.8	07.1	62	161.6	11.3	22	221.5	15.5	82	281.3	19.7
43	42.9	03.0	03	102.7	07.2	63	162.6	11.4	23	222.5	15.6	83	282.3	19.7
44	43.9	03.1	04	103.7	07.3	64	163.6	11.4	24	223.5	15.6	84	283.3	19.8
45	44.9	03.1	05	104.7	07.3	65	164.6	11.5	25	224.5	15.7	85	284.3	19.9
46	45.9	03.2	06	105.7	07.4	66	165.6	11.6	26	225.4	15.8	86	285.3	20.0
47	46.9	03.3	07	106.7	07.5	67	166.6	11.6	27	226.4	15.8	87	286.3	20.0
48	47.9	03.3	08	107.7	07.5	68	167.6	11.7	28	227.4	15.9	88	287.3	20.1
49	48.9	03.4	09	108.7	07.6	69	168.6	11.8	29	228.4	16.0	89	288.3	20.2
50	49.9	03.5	10	109.7	07.7	70	169.6	11.9	30	229.4	16.0	90	289.3	20.2
51	50.9	03.6	111	110.7	07.7	171	170.6	11.9	231	230.4	16.1	291	290.3	20.3
52	51.9	03.6	12	111.7	07.8	72	171.6	12.0	32	231.4	16.2	92	291.3	20.4
53	52.9	03.7	13	112.7	07.9	73	172.6	12.1	33	232.4	16.3	93	292.3	20.4
54	53.9	03.8	14	113.7	08.0	74	173.6	12.1	34	233.4	16.3	94	293.3	20.5
55	54.9	03.8	15	114.7	08.0	75	174.6	12.2	35	234.4	16.4	95	294.3	20.6
56	55.9	03.9	16	115.7	08.1	76	175.6	12.3	36	235.4	16.5	96	295.3	20.6
57	56.9	04.0	17	116.7	08.2	77	176.6	12.3	37	236.4	16.5	97	296.3	20.7
58	57.9	04.0	18	117.7	08.2	78	177.6	12.4	38	237.4	16.6	98	297.3	20.8
59	58.9	04.1	19	118.7	08.3	79	178.6	12.5	39	238.4	16.7	99	298.3	20.9
60	59.9	04.2	20	119.7	08.4	80	179.6	12.6	40	239.4	16.7	300	299.3	20.9
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 86 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.1	61	60.9	03.2	121	120.8	06.3	181	180.7	09.5	241	240.7	12.6
2	02.0	00.1	62	61.9	03.2	22	121.8	06.4	82	181.7	09.5	42	241.7	12.7
3	03.0	00.2	63	62.9	03.3	23	122.8	06.4	83	182.7	09.6	43	242.7	12.7
4	04.0	00.2	64	63.9	03.3	24	123.8	06.5	84	183.7	09.6	44	243.7	12.8
5	05.0	00.3	65	64.9	03.4	25	124.8	06.5	85	184.7	09.7	45	244.7	12.8
6	06.0	00.3	66	65.9	03.5	26	125.8	06.6	86	185.7	09.7	46	245.7	12.9
7	07.0	00.4	67	66.9	03.5	27	126.8	06.6	87	186.7	09.8	47	246.7	12.9
8	08.0	00.4	68	67.9	03.6	28	127.8	06.7	88	187.7	09.8	48	247.7	13.0
9	09.0	00.5	69	68.9	03.6	29	128.8	06.8	89	188.7	09.9	49	248.7	13.0
10	10.0	00.5	70	69.9	03.7	30	129.8	06.8	90	189.7	09.9	50	249.7	13.1
11	11.0	00.6	71	70.9	03.7	131	130.8	06.9	191	190.7	10.0	251	250.7	13.1
12	12.0	00.6	72	71.9	03.8	32	131.8	06.9	92	191.7	10.0	52	251.7	13.2
13	13.0	00.7	73	72.9	03.8	33	132.8	07.0	93	192.7	10.1	53	252.7	13.2
14	14.0	00.7	74	73.9	03.9	34	133.8	07.0	94	193.7	10.2	54	253.7	13.3
15	15.0	00.8	75	74.9	03.9	35	134.8	07.1	95	194.7	10.2	55	254.7	13.3
16	16.0	00.8	76	75.9	04.0	36	135.8	07.1	96	195.7	10.3	56	255.6	13.4
17	17.0	00.9	77	76.9	04.0	37	136.8	07.2	97	196.7	10.3	57	256.6	13.5
18	18.0	00.9	78	77.9	04.1	38	137.8	07.2	98	197.7	10.4	58	257.6	13.5
19	19.0	01.0	79	78.9	04.1	39	138.8	07.3	99	198.7	10.4	59	258.6	13.6
20	20.0	01.0	80	79.9	04.2	40	139.8	07.3	200	199.7	10.5	60	259.6	13.6
21	21.0	01.1	81	80.9	04.2	141	140.8	07.4	201	200.7	10.5	261	260.6	13.7
22	22.0	01.1	82	81.9	04.3	42	141.8	07.4	02	201.7	10.6	62	261.6	13.7
23	23.0	01.2	83	82.9	04.3	43	142.8	07.5	03	202.7	10.6	63	262.6	13.8
24	24.0	01.3	84	83.9	04.4	44	143.8	07.5	04	203.7	10.7	64	263.6	13.8
25	25.0	01.3	85	84.9	04.4	45	144.8	07.6	05	204.7	10.7	65	264.6	13.9
26	26.0	01.4	86	85.9	04.5	46	145.8	07.6	06	205.7	10.8	66	265.6	13.9
27	27.0	01.4	87	86.9	04.6	47	146.8	07.7	07	206.7	10.8	67	266.6	14.0
28	28.0	01.5	88	87.9	04.6	48	147.8	07.7	08	207.7	10.9	68	267.6	14.0
29	29.0	01.5	89	88.9	04.7	49	148.8	07.8	09	208.7	10.9	69	268.6	14.1
30	30.0	01.6	90	89.9	04.7	50	149.8	07.9	10	209.7	11.0	70	269.6	14.1
31	31.0	01.6	91	90.9	04.8	151	150.8	07.9	211	210.7	11.0	271	270.6	14.2
32	32.0	01.7	92	91.9	04.8	52	151.8	08.0	12	211.7	11.1	72	271.6	14.2
33	33.0	01.7	93	92.9	04.9	53	152.8	08.0	13	212.7	11.1	73	272.6	14.3
34	34.0	01.8	94	93.9	04.9	54	153.8	08.1	14	213.7	11.2	74	273.6	14.3
35	35.0	01.8	95	94.9	05.0	55	154.8	08.1	15	214.7	11.3	75	274.6	14.4
36	36.0	01.9	96	95.9	05.0	56	155.8	08.2	16	215.7	11.3	76	275.6	14.4
37	36.9	01.9	97	96.9	05.1	57	156.8	08.2	17	216.7	11.4	77	276.6	14.5
38	37.9	02.0	98	97.9	05.1	58	157.8	08.3	18	217.7	11.4	78	277.6	14.5
39	38.9	02.0	99	98.9	05.2	59	158.8	08.3	19	218.7	11.5	79	278.6	14.6
40	39.9	02.1	100	99.9	05.2	60	159.8	08.4	20	219.7	11.5	80	279.6	14.7
41	40.9	02.1	101	100.9	05.3	161	160.8	08.4	221	220.7	11.6	281	280.6	14.7
42	41.9	02.2	02	101.9	05.3	62	161.8	08.5	22	221.7	11.6	82	281.6	14.8
43	42.9	02.3	03	102.9	05.4	63	162.8	08.5	23	222.7	11.7	83	282.6	14.8
44	43.9	02.3	04	103.9	05.4	64	163.8	08.6	24	223.7	11.7	84	283.6	14.9
45	44.9	02.4	05	104.9	05.5	65	164.8	08.6	25	224.7	11.8	85	284.6	14.9
46	45.9	02.4	06	105.9	05.5	66	165.8	08.7	26	225.7	11.8	86	285.6	15.0
47	46.9	02.5	07	106.9	05.6	67	166.8	08.7	27	226.7	11.9	87	286.6	15.0
48	47.9	02.5	08	107.9	05.7	68	167.8	08.8	28	227.7	11.9	88	287.6	15.1
49	48.9	02.6	09	108.8	05.7	69	168.8	08.8	29	228.7	12.0	89	288.6	15.1
50	49.9	02.6	10	109.8	05.8	70	169.8	08.9	30	229.7	12.0	90	289.6	15.2
51	50.9	02.7	111	110.8	05.8	171	170.8	08.9	231	230.7	12.1	291	290.6	15.2
52	51.9	02.7	12	111.8	05.9	72	171.8	09.0	32	231.7	12.1	92	291.6	15.3
53	52.9	02.8	13	112.8	05.9	73	172.8	09.1	33	232.7	12.2	93	292.6	15.3
54	53.9	02.8	14	113.8	06.0	74	173.8	09.1	34	233.7	12.2	94	293.6	15.4
55	54.9	02.9	15	114.8	06.0	75	174.8	09.2	35	234.7	12.3	95	294.6	15.4
56	55.9	02.9	16	115.8	06.1	76	175.8	09.2	36	235.7	12.4	96	295.6	15.5
57	56.9	03.0	17	116.8	06.1	77	176.8	09.3	37	236.7	12.4	97	296.6	15.5
58	57.9	03.0	18	117.8	06.2	78	177.8	09.3	38	237.7	12.5	98	297.6	15.6
59	58.9	03.1	19	118.8	06.2	79	178.8	09.4	39	238.7	12.5	99	298.6	15.6
60	59.9	03.1	20	119.8	06.3	80	179.8	09.4	40	239.7	12.6	300	299.6	15.7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Table II. Difference of Latitude and Departure for 6 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.1	61	60.7	06.4	121	120.3	12.6	181	180.0	18.9	241	239.7	25.2
2	02.0	00.2	62	61.7	06.5	22	121.3	12.8	82	181.0	19.0	42	240.7	25.3
3	03.0	00.3	63	62.7	06.6	23	122.3	12.9	83	182.0	19.1	43	241.7	25.4
4	04.0	00.4	64	63.6	06.7	24	123.3	13.0	84	183.0	19.2	44	242.7	25.5
5	05.0	00.5	65	64.6	06.8	25	124.3	13.1	85	184.0	19.3	45	243.7	25.6
6	06.0	00.6	66	65.6	06.9	26	125.3	13.2	86	185.0	19.4	46	244.7	25.7
7	07.0	00.7	67	66.6	07.0	27	126.3	13.3	87	186.0	19.5	47	245.6	25.8
8	08.0	00.8	68	67.6	07.1	28	127.3	13.4	88	187.0	19.7	48	246.6	25.9
9	09.0	00.9	69	68.6	07.2	29	128.3	13.5	89	188.0	19.8	49	247.6	26.0
10	09.9	01.0	70	69.6	07.3	30	129.3	13.6	90	189.0	19.9	50	248.6	26.1
11	10.9	01.1	71	70.6	07.4	131	130.3	13.7	191	190.0	20.0	251	249.6	26.2
12	11.9	01.3	72	71.6	07.5	32	131.3	13.8	92	190.9	20.1	52	250.6	26.3
13	12.9	01.4	73	72.6	07.6	33	132.3	13.9	93	191.9	20.2	53	251.6	26.4
14	13.9	01.5	74	73.6	07.7	34	133.3	14.0	94	192.9	20.3	54	252.6	26.6
15	14.9	01.6	75	74.6	07.8	35	134.3	14.1	95	193.9	20.4	55	253.6	26.7
16	15.9	01.7	76	75.6	07.9	36	135.3	14.2	96	194.9	20.5	56	254.6	26.8
17	16.9	01.8	77	76.6	08.0	37	136.2	14.3	97	195.9	20.6	57	255.6	26.9
18	17.9	01.9	78	77.6	08.2	38	137.2	14.4	98	196.9	20.7	58	256.6	27.0
19	18.9	02.0	79	78.6	08.3	39	138.2	14.5	99	197.9	20.8	59	257.6	27.1
20	19.9	02.1	80	79.6	08.4	40	139.2	14.6	200	198.9	20.9	60	258.6	27.2
21	20.9	02.2	81	80.6	08.5	141	140.2	14.7	201	199.9	21.0	261	259.6	27.3
22	21.9	02.3	82	81.6	08.6	42	141.2	14.8	02	200.9	21.1	62	260.6	27.4
23	22.9	02.4	83	82.5	08.7	43	142.2	14.9	03	201.9	21.2	63	261.6	27.5
24	23.9	02.5	84	83.5	08.8	44	143.2	15.0	04	202.9	21.3	64	262.6	27.6
25	24.9	02.6	85	84.5	08.9	45	144.2	15.1	05	203.9	21.4	65	263.5	27.7
26	25.9	02.7	86	85.5	09.0	46	145.2	15.3	06	204.9	21.5	66	264.5	27.8
27	26.9	02.8	87	86.5	09.1	47	146.2	15.4	07	205.9	21.6	67	265.5	27.9
28	27.8	02.9	88	87.5	09.2	48	147.2	15.5	08	206.9	21.7	68	266.5	28.0
29	28.8	03.0	89	88.5	09.3	49	148.2	15.6	09	207.9	21.8	69	267.5	28.1
30	29.8	03.1	90	89.5	09.4	50	149.2	15.7	10	208.8	22.0	70	268.5	28.2
31	30.8	03.2	91	90.5	09.5	151	150.2	15.8	211	209.8	22.1	271	269.5	28.3
32	31.8	03.3	92	91.5	09.6	52	151.2	15.9	12	210.8	22.2	72	270.5	28.4
33	32.8	03.4	93	92.5	09.7	53	152.2	16.0	13	211.8	22.3	73	271.5	28.5
34	33.8	03.6	94	93.5	09.8	54	153.2	16.1	14	212.8	22.4	74	272.5	28.6
35	34.8	03.7	95	94.5	09.9	55	154.2	16.2	15	213.8	22.5	75	273.5	28.7
36	35.8	03.8	96	95.5	10.0	56	155.1	16.3	16	214.8	22.6	76	274.5	28.8
37	36.8	03.9	97	96.5	10.1	57	156.1	16.4	17	215.8	22.7	77	275.5	29.0
38	37.8	04.0	98	97.5	10.2	58	157.1	16.5	18	216.8	22.8	78	276.5	29.1
39	38.8	04.1	99	98.5	10.3	59	158.1	16.6	19	217.8	22.9	79	277.5	29.2
40	39.8	04.2	100	99.5	10.5	60	159.1	16.7	20	218.8	23.0	80	278.5	29.3
41	40.8	04.3	101	100.4	10.6	161	160.1	16.8	221	219.8	23.1	281	279.5	29.4
42	41.8	04.4	02	101.4	10.7	62	161.1	16.9	22	220.8	23.2	82	280.5	29.5
43	42.8	04.5	03	102.4	10.8	63	162.1	17.0	23	221.8	23.3	83	281.4	29.6
44	43.8	04.6	04	103.4	10.9	64	163.1	17.1	24	222.8	23.4	84	282.4	29.7
45	44.8	04.7	05	104.4	11.0	65	164.1	17.2	25	223.8	23.5	85	283.4	29.8
46	45.7	04.8	06	105.4	11.1	66	165.1	17.4	26	224.8	23.6	86	284.4	29.9
47	46.7	04.9	07	106.4	11.2	67	166.1	17.5	27	225.8	23.7	87	285.4	30.0
48	47.7	05.0	08	107.4	11.3	68	167.1	17.6	28	226.8	23.8	88	286.4	30.1
49	48.7	05.1	09	108.4	11.4	69	168.1	17.7	29	227.7	23.9	89	287.4	30.2
50	49.7	05.2	10	109.4	11.5	70	169.1	17.8	30	228.7	24.0	90	288.4	30.3
51	50.7	05.3	111	110.4	11.6	171	170.1	17.9	231	229.7	24.1	291	289.4	30.4
52	51.7	05.4	12	111.4	11.7	72	171.1	18.0	32	230.7	24.3	92	290.4	30.5
53	52.7	05.5	13	112.4	11.8	73	172.1	18.1	33	231.7	24.4	93	291.4	30.6
54	53.7	05.6	14	113.4	11.9	74	173.0	18.2	34	232.7	24.5	94	292.4	30.7
55	54.7	05.7	15	114.4	12.0	75	174.0	18.3	35	233.7	24.6	95	293.4	30.8
56	55.7	05.9	16	115.4	12.1	76	175.0	18.4	36	234.7	24.7	96	294.4	30.9
57	56.7	06.0	17	116.4	12.2	77	176.0	18.5	37	235.7	24.8	97	295.4	31.0
58	57.7	06.1	18	117.4	12.3	78	177.0	18.6	38	236.7	24.9	98	296.4	31.1
59	58.7	06.2	19	118.3	12.4	79	178.0	18.7	39	237.7	25.0	99	297.4	31.3
60	59.7	06.3	20	119.3	12.5	80	179.0	18.8	40	238.7	25.1	300	298.4	31.4
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 84 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.1	61	60.8	05.3	121	120.5	10.5	181	180.3	15.8	241	240.1	21.0
2	02.0	00.2	62	61.8	05.4	22	121.5	10.6	82	181.3	15.9	42	241.1	21.1
3	03.0	00.3	63	62.8	05.5	23	122.5	10.7	83	182.3	15.9	43	242.1	21.2
4	04.0	00.3	64	63.8	05.6	24	123.5	10.8	84	183.3	16.0	44	243.1	21.3
5	05.0	00.4	65	64.8	05.7	25	124.5	10.9	85	184.3	16.1	45	244.1	21.4
6	06.0	00.5	66	65.7	05.8	26	125.5	11.0	86	185.3	16.2	46	245.1	21.4
7	07.0	00.6	67	66.7	05.8	27	126.5	11.1	87	186.3	16.3	47	246.1	21.5
8	08.0	00.7	68	67.7	05.9	28	127.5	11.2	88	187.3	16.4	48	247.1	21.6
9	09.0	00.8	69	68.7	06.0	29	128.5	11.2	89	188.3	16.5	49	248.1	21.7
10	10.0	00.9	70	69.7	06.1	30	129.5	11.3	90	189.3	16.6	50	249.0	21.8
11	11.0	01.0	71	70.7	06.2	131	130.5	11.4	191	190.3	16.6	251	250.0	21.9
12	12.0	01.0	72	71.7	06.3	32	131.5	11.5	92	191.3	16.7	52	251.0	22.0
13	13.0	01.1	73	72.7	06.4	33	132.5	11.6	93	192.3	16.8	53	252.0	22.1
14	13.9	01.2	74	73.7	06.4	34	133.5	11.7	94	193.3	16.9	54	253.0	22.1
15	14.9	01.3	75	74.7	06.5	35	134.5	11.8	95	194.3	17.0	55	254.0	22.2
16	15.9	01.4	76	75.7	06.6	36	135.5	11.9	96	195.3	17.1	56	255.0	22.3
17	16.9	01.5	77	76.7	06.7	37	136.5	11.9	97	196.3	17.2	57	256.0	22.4
18	17.9	01.6	78	77.7	06.8	38	137.5	12.0	98	197.2	17.3	58	257.0	22.5
19	18.9	01.7	79	78.7	06.9	39	138.5	12.1	99	198.2	17.3	59	258.0	22.6
20	19.9	01.7	80	79.7	07.0	40	139.5	12.2	200	199.2	17.4	60	259.0	22.7
21	20.9	01.8	81	80.7	07.1	141	140.5	12.3	201	200.2	17.5	261	260.0	22.7
22	21.9	01.9	82	81.7	07.1	42	141.5	12.4	02	201.2	17.6	62	261.0	22.8
23	22.9	02.0	83	82.7	07.2	43	142.5	12.5	03	202.2	17.7	63	262.0	22.9
24	23.9	02.1	84	83.7	07.3	44	143.5	12.6	04	203.2	17.8	64	263.0	23.0
25	24.9	02.2	85	84.7	07.4	45	144.4	12.6	05	204.2	17.9	65	264.0	23.1
26	25.9	02.3	86	85.7	07.5	46	145.4	12.7	06	205.2	18.0	66	265.0	23.2
27	26.9	02.4	87	86.7	07.6	47	146.4	12.8	07	206.2	18.0	67	266.0	23.3
28	27.9	02.4	88	87.7	07.7	48	147.4	12.9	08	207.2	18.1	68	267.0	23.4
29	28.9	02.5	89	88.7	07.8	49	148.4	13.0	09	208.2	18.2	69	268.0	23.4
30	29.9	02.6	90	89.7	07.8	50	149.4	13.1	10	209.2	18.3	70	269.0	23.5
31	30.9	02.7	91	90.7	07.9	151	150.4	13.2	211	210.2	18.4	271	270.0	23.6
32	31.9	02.8	92	91.6	08.0	52	151.4	13.2	12	211.2	18.5	72	271.0	23.7
33	32.9	02.9	93	92.6	08.1	53	152.4	13.3	13	212.2	18.6	73	272.0	23.8
34	33.9	03.0	94	93.6	08.2	54	153.4	13.4	14	213.2	18.7	74	273.0	23.9
35	34.9	03.1	95	94.6	08.3	55	154.4	13.5	15	214.2	18.7	75	274.0	24.0
36	35.9	03.1	96	95.6	08.4	56	155.4	13.6	16	215.2	18.8	76	274.9	24.1
37	36.9	03.2	97	96.6	08.5	57	156.4	13.7	17	216.2	18.9	77	275.9	24.1
38	37.9	03.3	98	97.6	08.5	58	157.4	13.8	18	217.2	19.0	78	276.9	24.2
39	38.9	03.4	99	98.6	08.6	59	158.4	13.9	19	218.2	19.1	79	277.9	24.3
40	39.8	03.5	100	99.6	08.7	60	159.4	13.9	20	219.2	19.2	80	278.9	24.4
41	40.8	03.6	101	100.6	08.8	161	160.4	14.0	221	220.2	19.3	281	279.9	24.5
42	41.8	03.7	02	101.6	08.9	62	161.4	14.1	22	221.2	19.3	82	280.9	24.6
43	42.8	03.7	03	102.6	09.0	63	162.4	14.2	23	222.2	19.4	83	281.9	24.7
44	43.8	03.8	04	103.6	09.1	64	163.4	14.3	24	223.1	19.5	84	282.9	24.8
45	44.8	03.9	05	104.6	09.2	65	164.4	14.4	25	224.1	19.6	85	283.9	24.8
46	45.8	04.0	06	105.6	09.2	66	165.4	14.5	26	225.1	19.7	86	284.9	24.9
47	46.8	04.1	07	106.6	09.3	67	166.4	14.6	27	226.1	19.8	87	285.9	25.0
48	47.8	04.2	08	107.6	09.4	68	167.4	14.6	28	227.1	19.9	88	286.9	25.1
49	48.8	04.3	09	108.6	09.5	69	168.4	14.7	29	228.1	20.0	89	287.9	25.2
50	49.8	04.4	10	109.6	09.6	70	169.4	14.8	30	229.1	20.0	90	288.9	25.3
51	50.8	04.4	111	110.6	09.7	171	170.3	14.9	231	230.1	20.1	291	289.9	25.4
52	51.8	04.5	12	111.6	09.8	72	171.3	15.0	32	231.1	20.2	92	290.9	25.4
53	52.8	04.6	13	112.6	09.8	73	172.3	15.1	33	232.1	20.3	93	291.9	25.5
54	53.8	04.7	14	113.6	09.9	74	173.3	15.2	34	233.1	20.4	94	292.9	25.6
55	54.8	04.8	15	114.6	10.0	75	174.3	15.3	35	234.1	20.5	95	293.9	25.7
56	55.8	04.9	16	115.6	10.1	76	175.3	15.3	36	235.1	20.6	96	294.9	25.8
57	56.8	05.0	17	116.6	10.2	77	176.3	15.4	37	236.1	20.7	97	295.9	25.9
58	57.8	05.1	18	117.6	10.3	78	177.3	15.5	38	237.1	20.7	98	296.9	26.0
59	58.8	05.1	19	118.5	10.4	79	178.3	15.6	39	238.1	20.8	99	297.9	26.1
60	59.8	05.2	20	119.5	10.5	80	179.3	15.7	40	239.1	20.9	300	298.9	26.1
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 85 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.1	61	60.4	08.5	121	119.8	16.8	181	179.2	25.2	241	238.7	33.5
2	02.0	00.3	62	61.4	08.6	22	120.8	17.0	82	180.2	25.3	42	239.7	33.7
3	03.0	00.4	63	62.4	08.8	23	121.8	17.1	83	181.2	25.5	43	240.6	33.8
4	04.0	00.6	64	63.4	08.9	24	122.8	17.3	84	182.2	25.6	44	241.6	34.0
5	05.0	00.7	65	64.4	09.0	25	123.8	17.4	85	183.2	25.7	45	242.6	34.1
6	05.9	00.8	66	65.4	09.2	26	124.8	17.5	86	184.2	25.9	46	243.6	34.2
7	06.9	01.0	67	66.3	09.3	27	125.8	17.7	87	185.2	26.0	47	244.6	34.4
8	07.9	01.1	68	67.3	09.5	28	126.8	17.8	88	186.2	26.2	48	245.6	34.5
9	08.9	01.3	69	68.3	09.6	29	127.7	18.0	89	187.2	26.3	49	246.6	34.7
10	09.9	01.4	70	69.3	09.7	30	128.7	18.1	90	188.2	26.4	50	247.6	34.8
11	10.9	01.5	71	70.3	09.9	131	129.7	18.2	191	189.1	26.6	251	248.6	34.9
12	11.9	01.7	72	71.3	10.0	32	130.7	18.4	92	190.1	26.7	52	249.5	35.1
13	12.9	01.8	73	72.3	10.2	33	131.7	18.5	93	191.1	26.9	53	250.5	35.2
14	13.9	01.9	74	73.3	10.3	34	132.7	18.6	94	192.1	27.0	54	251.5	35.3
15	14.9	02.1	75	74.3	10.4	35	133.7	18.8	95	193.1	27.1	55	252.5	35.5
16	15.8	02.2	76	75.3	10.6	36	134.7	18.9	96	194.1	27.3	56	253.5	35.6
17	16.8	02.4	77	76.3	10.7	37	135.7	19.1	97	195.1	27.4	57	254.5	35.8
18	17.8	02.5	78	77.2	10.9	38	136.7	19.2	98	196.1	27.6	58	255.5	35.9
19	18.8	02.6	79	78.2	11.0	39	137.7	19.3	99	197.1	27.7	59	256.5	36.0
20	19.8	02.8	80	79.2	11.1	40	138.6	19.5	200	198.1	27.8	60	257.5	36.2
21	20.8	02.9	81	80.2	11.3	141	139.6	19.6	201	199.0	28.0	261	258.5	36.3
22	21.8	03.1	82	81.2	11.4	42	140.6	19.8	02	200.0	28.1	62	259.5	36.5
23	22.8	03.2	83	82.2	11.6	43	141.6	19.9	03	201.0	28.3	63	260.4	36.6
24	23.8	03.3	84	83.2	11.7	44	142.6	20.0	04	202.0	28.4	64	261.4	36.7
25	24.8	03.5	85	84.2	11.8	45	143.6	20.2	05	203.0	28.5	65	262.4	36.9
26	25.7	03.6	86	85.2	12.0	46	144.6	20.3	06	204.0	28.7	66	263.4	37.0
27	26.7	03.8	87	86.2	12.1	47	145.6	20.5	07	205.0	28.8	67	264.4	37.2
28	27.7	03.9	88	87.1	12.2	48	146.6	20.6	08	206.0	28.9	68	265.4	37.3
29	28.7	04.0	89	88.1	12.4	49	147.5	20.7	09	207.0	29.1	69	266.4	37.4
30	29.7	04.2	90	89.1	12.5	50	148.5	20.9	10	208.0	29.2	70	267.4	37.6
31	30.7	04.3	91	90.1	12.7	151	149.5	21.0	211	208.9	29.4	271	268.4	37.7
32	31.7	04.5	92	91.1	12.8	52	150.5	21.2	12	209.9	29.5	72	269.4	37.9
33	32.7	04.6	93	92.1	12.9	53	151.5	21.3	13	210.9	29.6	73	270.3	38.0
34	33.7	04.7	94	93.1	13.1	54	152.5	21.4	14	211.9	29.8	74	271.3	38.1
35	34.7	04.9	95	94.1	13.2	55	153.5	21.6	15	212.9	29.9	75	272.3	38.3
36	35.6	05.0	96	95.1	13.4	56	154.5	21.7	16	213.9	30.1	76	273.3	38.4
37	36.6	05.2	97	96.1	13.5	57	155.5	21.9	17	214.9	30.2	77	274.3	38.6
38	37.6	05.3	98	97.0	13.6	58	156.5	22.0	18	215.9	30.3	78	275.3	38.7
39	38.6	05.4	99	98.0	13.8	59	157.5	22.1	19	216.9	30.5	79	276.3	38.8
40	39.6	05.6	100	99.0	13.9	60	158.4	22.3	20	217.9	30.6	80	277.3	39.0
41	40.6	05.7	101	100.0	14.1	161	159.4	22.4	221	218.8	30.8	281	278.3	39.1
42	41.6	05.8	02	101.0	14.2	62	160.4	22.5	22	219.8	30.9	82	279.3	39.2
43	42.6	06.0	03	102.0	14.3	63	161.4	22.7	23	220.8	31.0	83	280.2	39.4
44	43.6	06.1	04	103.0	14.5	64	162.4	22.8	24	221.8	31.2	84	281.2	39.5
45	44.6	06.3	05	104.0	14.6	65	163.4	23.0	25	222.8	31.3	85	282.2	39.7
46	45.6	06.4	06	105.0	14.8	66	164.4	23.1	26	223.8	31.5	86	283.2	39.8
47	46.5	06.5	07	106.0	14.9	67	165.4	23.2	27	224.8	31.6	87	284.2	39.9
48	47.5	06.7	08	107.0	15.0	68	166.4	23.4	28	225.8	31.7	88	285.2	40.1
49	48.5	06.8	09	107.9	15.2	69	167.4	23.5	29	226.8	31.9	89	286.2	40.2
50	49.5	07.0	10	108.9	15.3	70	168.3	23.7	30	227.8	32.0	90	287.2	40.4
51	50.5	07.1	111	109.9	15.4	171	169.3	23.8	231	228.8	32.1	291	288.2	40.5
52	51.5	07.2	12	110.9	15.6	72	170.3	23.9	32	229.7	32.3	92	289.2	40.6
53	52.5	07.4	13	111.9	15.7	73	171.3	24.1	33	230.7	32.4	93	290.1	40.8
54	53.5	07.5	14	112.9	15.9	74	172.3	24.2	34	231.7	32.6	94	291.1	40.9
55	54.5	07.7	15	113.9	16.0	75	173.3	24.4	35	232.7	32.7	95	292.1	41.1
56	55.5	07.8	16	114.9	16.1	76	174.3	24.5	36	233.7	32.8	96	293.1	41.2
57	56.4	07.9	17	115.9	16.3	77	175.3	24.6	37	234.7	33.0	97	294.1	41.3
58	57.4	08.1	18	116.9	16.4	78	176.3	24.7	38	235.7	33.1	98	295.1	41.5
59	58.4	08.2	19	117.8	16.6	79	177.3	24.9	39	236.7	33.3	99	296.1	41.6
60	59.4	08.4	20	118.8	16.7	80	178.3	25.1	40	237.7	33.4	300	297.1	41.8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 82 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.2	61	60.2	09.5	121	119.5	18.9	181	178.8	28.3	241	238.0	37.7
2	02.0	00.3	62	61.2	09.7	22	120.5	19.1	82	179.8	28.5	42	239.0	37.9
3	03.0	00.5	63	62.2	09.9	23	121.5	19.2	83	180.7	28.6	43	240.0	38.0
4	04.0	00.6	64	63.2	10.0	24	122.5	19.4	84	181.7	28.8	44	241.0	38.2
5	04.9	00.8	65	64.2	10.2	25	123.5	19.6	85	182.7	28.9	45	242.0	38.3
6	05.9	00.9	66	65.2	10.3	26	124.4	19.7	86	183.7	29.1	46	243.0	38.5
7	06.9	01.1	67	66.2	10.5	27	125.4	19.9	87	184.7	29.3	47	244.0	38.6
8	07.9	01.3	68	67.2	10.6	28	126.4	20.0	88	185.7	29.4	48	244.9	38.8
9	08.9	01.4	69	68.2	10.8	29	127.4	20.2	89	186.7	29.6	49	245.9	39.0
10	09.9	01.6	70	69.1	11.0	30	128.4	20.3	90	187.7	29.7	50	246.9	39.1
11	10.9	01.7	71	70.1	11.1	131	129.4	20.5	191	188.6	29.9	251	247.9	39.3
12	11.9	01.9	72	71.1	11.3	32	130.4	20.6	92	189.6	30.0	52	248.9	39.4
13	12.8	02.0	73	72.1	11.4	33	131.4	20.8	93	190.6	30.2	53	249.9	39.6
14	13.8	02.2	74	73.1	11.6	34	132.4	21.0	94	191.6	30.3	54	250.9	39.7
15	14.8	02.3	75	74.1	11.7	35	133.3	21.1	95	192.6	30.5	55	251.9	39.9
16	15.8	02.5	76	75.1	11.9	36	134.3	21.3	96	193.6	30.7	56	252.8	40.0
17	16.8	02.7	77	76.1	12.0	37	135.3	21.4	97	194.6	30.8	57	253.8	40.2
18	17.8	02.8	78	77.0	12.2	38	136.3	21.6	98	195.6	31.0	58	254.8	40.4
19	18.8	03.0	79	78.0	12.4	39	137.3	21.7	99	196.5	31.1	59	255.8	40.5
20	19.8	03.1	80	79.0	12.5	40	138.3	21.9	200	197.5	31.3	60	256.8	40.7
21	20.7	03.3	81	80.0	12.7	141	139.3	22.1	201	198.5	31.4	261	257.8	40.8
22	21.7	03.4	82	81.0	12.8	42	140.3	22.2	02	199.5	31.6	62	258.8	41.0
23	22.7	03.6	83	82.0	13.0	43	141.2	22.4	03	200.5	31.8	63	259.8	41.1
24	23.7	03.8	84	83.0	13.1	44	142.2	22.5	04	201.5	31.9	64	260.7	41.3
25	24.7	03.9	85	84.0	13.3	45	143.2	22.7	05	202.5	32.1	65	261.7	41.5
26	25.7	04.1	86	84.9	13.5	46	144.2	22.8	06	203.5	32.2	66	262.7	41.6
27	26.7	04.2	87	85.9	13.6	47	145.2	23.0	07	204.5	32.4	67	263.7	41.8
28	27.7	04.4	88	86.9	13.8	48	146.2	23.2	08	205.4	32.5	68	264.7	41.9
29	28.6	04.5	89	87.9	13.9	49	147.2	23.3	09	206.4	32.7	69	265.7	42.1
30	29.6	04.7	90	88.9	14.1	50	148.2	23.5	10	207.4	32.9	70	266.7	42.2
31	30.6	04.8	91	89.9	14.2	151	149.1	23.6	211	208.4	33.0	271	267.7	42.4
32	31.6	05.0	92	90.9	14.4	52	150.1	23.8	12	209.4	33.2	72	268.7	42.6
33	32.6	05.2	93	91.9	14.5	53	151.1	23.9	13	210.4	33.3	73	269.6	42.7
34	33.6	05.3	94	92.8	14.7	54	152.1	24.1	14	211.4	33.5	74	270.6	42.9
35	34.6	05.5	95	93.8	14.9	55	153.1	24.2	15	212.4	33.6	75	271.6	43.0
36	35.6	05.6	96	94.8	15.0	56	154.1	24.4	16	213.3	33.8	76	272.6	43.2
37	36.5	05.8	97	95.8	15.2	57	155.1	24.6	17	214.3	33.9	77	273.6	43.3
38	37.5	05.9	98	96.8	15.3	58	156.1	24.7	18	215.3	34.1	78	274.6	43.5
39	38.5	06.1	99	97.8	15.5	59	157.0	24.9	19	216.3	34.3	79	275.6	43.6
40	39.5	06.3	100	98.8	15.6	60	158.0	25.0	20	217.3	34.4	80	276.6	43.8
41	40.5	06.4	101	99.8	15.8	161	159.0	25.2	221	218.3	34.6	281	277.5	44.0
42	41.5	06.6	02	100.7	16.0	62	160.0	25.3	22	219.3	34.7	82	278.5	44.1
43	42.5	06.7	03	101.7	16.1	63	161.0	25.5	23	220.3	34.9	83	279.5	44.3
44	43.5	06.9	04	102.7	16.3	64	162.0	25.7	24	221.2	35.0	84	280.5	44.4
45	44.4	07.0	05	103.7	16.4	65	163.0	25.8	25	222.2	35.2	85	281.5	44.6
46	45.4	07.2	06	104.7	16.6	66	164.0	26.0	26	223.2	35.4	86	282.5	44.7
47	46.4	07.4	07	105.7	16.7	67	164.9	26.1	27	224.2	35.5	87	283.5	44.9
48	47.4	07.5	08	106.7	16.9	68	165.9	26.3	28	225.2	35.7	88	284.5	45.1
49	48.4	07.7	09	107.7	17.1	69	166.9	26.4	29	226.2	35.8	89	285.4	45.2
50	49.4	07.8	10	108.6	17.2	70	167.9	26.6	30	227.2	36.0	90	286.4	45.4
51	50.4	08.0	111	109.6	17.4	171	168.9	26.8	231	228.2	36.1	291	287.4	45.5
52	51.4	08.1	12	110.6	17.5	72	169.9	26.9	32	229.1	36.3	92	288.4	45.7
53	52.3	08.3	13	111.6	17.7	73	170.9	27.1	33	230.1	36.4	93	289.4	45.8
54	53.3	08.4	14	112.6	17.8	74	171.9	27.2	34	231.1	36.6	94	290.4	46.0
55	54.3	08.6	15	113.6	18.0	75	172.8	27.4	35	232.1	36.8	95	291.4	46.1
56	55.3	08.8	16	114.6	18.1	76	173.8	27.5	36	233.1	36.9	96	292.4	46.3
57	56.3	08.9	17	115.6	18.3	77	174.8	27.7	37	234.1	37.1	97	293.3	46.5
58	57.3	09.1	18	116.5	18.5	78	175.8	27.8	38	235.1	37.2	98	294.3	46.6
59	58.3	09.2	19	117.5	18.6	79	176.8	28.0	39	236.1	37.4	99	295.3	46.8
60	59.3	09.4	20	118.5	18.8	80	177.8	28.2	40	237.0	37.5	300	296.3	46.9
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Table II. Difference of Latitude and Departure for 10 Degrees.

Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	01.0	00.2	61	60.1	10.6	121	119.2	21.0	181	178.3	31.4	241	237.3	41.8
2	02.0	00.3	62	61.1	10.8	22	120.1	21.2	82	179.2	31.6	42	238.3	42.0
3	03.0	0.5	63	62.0	10.9	23	121.1	21.4	83	180.2	31.8	43	239.3	42.2
4	03.9	00.7	64	63.0	11.1	24	122.1	21.5	84	181.2	32.0	44	240.3	42.4
5	04.9	00.9	65	64.0	11.2	25	123.1	21.7	85	182.2	32.1	45	241.3	42.5
6	05.9	01.0	66	65.0	11.3	26	124.1	21.9	86	183.2	32.3	46	242.3	42.7
7	06.9	01.2	67	66.0	11.5	27	125.1	22.0	87	184.2	32.5	47	243.2	42.9
8	07.9	01.4	68	67.0	11.8	28	126.1	22.1	88	185.1	32.6	48	244.2	43.1
9	08.9	01.6	69	68.0	12.0	29	127.0	22.4	89	186.1	32.8	49	245.2	43.2
10	09.8	01.7	70	68.9	12.2	30	128.0	22.6	90	187.1	33.0	50	246.2	43.4
11	10.8	01.9	71	69.9	12.3	131	129.0	22.7	191	188.1	33.2	251	247.2	43.5
12	11.8	02.1	72	70.9	12.5	32	130.0	22.9	92	189.1	33.3	52	248.2	43.8
13	12.8	02.3	73	71.9	12.7	33	131.0	23.1	93	190.1	33.5	53	249.2	43.9
14	13.8	02.4	74	72.9	12.8	34	132.0	23.3	94	191.1	33.7	54	250.1	44.1
15	14.8	02.6	75	73.9	13.0	35	132.9	23.4	95	192.0	33.9	55	251.1	44.3
16	15.8	02.8	76	74.8	13.2	36	133.9	23.6	96	193.0	34.0	56	252.1	44.5
17	16.7	03.0	77	75.8	13.4	37	134.9	23.8	97	194.0	34.2	57	253.1	44.6
18	17.7	03.1	78	76.8	13.5	38	135.9	24.0	98	195.0	34.4	58	254.1	44.8
19	18.7	03.3	79	77.8	13.7	39	136.9	24.1	99	196.0	34.6	59	255.1	45.0
20	19.7	03.5	80	78.8	13.9	40	137.9	24.3	200	197.0	34.7	60	256.0	45.1
21	20.7	03.6	81	79.8	14.1	141	138.9	24.5	201	197.9	34.9	261	257.0	45.3
22	21.7	03.8	82	80.8	14.2	42	139.8	24.7	02	198.9	35.1	62	258.0	45.5
23	22.7	04.0	83	81.7	14.4	43	140.8	24.8	03	199.9	35.3	63	259.0	45.7
24	23.6	04.2	84	82.7	14.6	44	141.8	25.0	04	200.9	35.4	64	260.0	45.8
25	24.6	04.3	85	83.7	14.8	45	142.8	25.2	05	201.9	35.6	65	261.0	46.0
26	25.6	04.5	86	84.7	14.9	46	143.8	25.4	06	202.9	35.8	66	262.0	46.2
27	26.6	04.7	87	85.7	15.1	47	144.8	25.5	07	203.9	35.9	67	262.9	46.4
28	27.6	04.9	88	86.7	15.3	48	145.8	25.7	08	204.8	36.1	68	263.9	46.5
29	28.6	05.0	89	87.6	15.5	49	146.7	25.9	09	205.8	36.3	69	264.9	46.7
30	29.5	05.2	90	88.6	15.6	50	147.7	26.0	10	206.8	36.5	70	265.9	46.9
31	30.5	05.4	91	89.6	15.8	151	148.7	26.2	211	207.8	36.6	271	266.9	47.1
32	31.5	05.6	92	90.6	16.0	52	149.7	26.4	12	208.8	36.8	72	267.9	47.2
33	32.5	05.7	93	91.6	16.1	53	150.7	26.6	13	209.8	37.0	73	268.9	47.4
34	33.5	05.9	94	92.6	16.3	54	151.7	26.7	14	210.7	37.2	74	269.8	47.6
35	34.5	06.1	95	93.6	16.5	55	152.6	26.9	15	211.7	37.3	75	270.8	47.8
36	35.5	06.3	96	94.5	16.7	56	153.6	27.1	16	212.7	37.5	76	271.8	47.9
37	36.4	06.4	97	95.5	16.8	57	154.6	27.3	17	213.7	37.7	77	272.8	48.1
38	37.4	06.6	98	96.5	17.0	58	155.6	27.4	18	214.7	37.9	78	273.8	48.3
39	38.4	06.8	99	97.5	17.2	59	156.6	27.6	19	215.7	38.0	79	274.8	48.4
40	39.4	06.9	100	98.5	17.3	60	157.6	27.8	20	216.7	38.2	80	275.7	48.6
41	40.4	07.1	101	199.5	17.4	161	158.6	28.0	221	217.6	38.4	281	276.7	48.8
42	41.4	07.3	02	100.5	17.7	62	159.5	28.1	22	218.6	38.5	82	277.7	49.0
43	42.3	07.5	03	101.4	17.9	63	160.5	28.3	23	219.6	38.7	83	278.7	49.1
44	43.3	07.6	04	102.4	18.1	64	161.5	28.5	24	220.6	38.9	84	279.7	49.3
45	44.3	07.8	05	103.4	18.2	65	162.5	28.7	25	221.6	39.0	85	280.7	49.5
46	45.3	08.0	06	104.4	18.4	66	163.5	28.8	26	222.6	39.2	86	281.7	49.7
47	46.3	08.2	07	105.4	18.6	67	164.5	29.0	27	223.6	39.4	87	282.6	49.8
48	47.3	08.3	08	106.4	18.8	68	165.4	29.2	28	224.5	39.6	88	283.6	50.0
49	48.3	08.5	09	107.3	18.9	69	166.4	29.3	29	225.5	39.8	89	284.6	50.2
50	49.2	08.7	10	108.3	19.1	70	167.4	29.5	30	226.5	39.9	90	285.6	50.4
51	50.2	08.9	111	109.3	19.3	171	168.4	29.7	231	227.5	40.1	291	286.6	50.5
52	51.2	09.0	12	110.3	19.4	72	169.4	29.9	32	228.5	40.3	92	287.6	50.7
53	52.2	09.2	13	111.3	19.6	73	170.4	30.0	33	229.5	40.5	93	288.5	50.9
54	53.2	09.4	14	112.3	19.8	74	171.4	30.2	34	230.4	40.6	94	289.5	51.1
55	54.2	09.6	15	113.3	20.0	75	172.3	30.4	35	231.4	40.8	95	290.5	51.2
56	55.1	09.7	16	114.2	20.1	76	173.3	30.6	36	232.4	41.0	96	291.5	51.4
57	56.1	09.9	17	115.2	20.3	77	174.3	30.7	37	233.4	41.2	97	292.5	51.6
58	57.1	10.1	18	116.2	20.5	78	175.3	30.9	38	234.4	41.3	98	293.5	51.7
59	58.1	10.2	19	117.2	20.7	79	176.3	31.1	39	235.4	41.5	99	294.5	51.9
60	59.1	10.4	20	118.2	20.8	80	177.3	31.3	40	236.4	41.7	300	295.4	52.1
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

for 80 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.2	61	60.2	09.5	121	119.5	18.9	181	178.8	28.3	241	238.0	37.7
2	02.0	00.3	62	61.2	09.7	22	120.5	19.1	82	179.8	28.5	42	239.0	37.9
3	03.0	00.5	63	62.2	09.9	23	121.5	19.2	83	180.7	28.6	43	240.0	38.0
4	04.0	00.6	64	63.2	10.0	24	122.5	19.4	84	181.7	28.8	44	241.0	38.2
5	04.9	00.8	65	64.2	10.2	25	123.5	19.6	85	182.7	28.9	45	242.0	38.3
6	05.9	00.9	66	65.2	10.3	26	124.4	19.7	86	183.7	29.1	46	243.0	38.5
7	06.9	01.1	67	66.2	10.5	27	125.4	19.9	87	184.7	29.3	47	244.0	38.6
8	07.9	01.3	68	67.2	10.6	28	126.4	20.0	88	185.7	29.4	48	244.9	38.8
9	08.9	01.4	69	68.2	10.8	29	127.4	20.2	89	186.7	29.6	49	245.9	39.0
10	09.9	01.6	70	69.1	11.0	30	128.4	20.3	90	187.7	29.7	50	246.9	39.1
11	10.9	01.7	71	70.1	11.1	131	129.4	20.5	191	188.6	29.9	251	247.9	39.3
12	11.9	01.9	72	71.1	11.3	32	130.4	20.6	92	189.6	30.0	52	248.9	39.4
13	12.8	02.0	73	72.1	11.4	33	131.4	20.8	93	190.6	30.2	53	249.9	39.6
14	13.8	02.2	74	73.1	11.6	34	132.4	21.0	94	191.6	30.3	54	250.9	39.7
15	14.8	02.3	75	74.1	11.7	35	133.3	21.1	95	192.6	30.5	55	251.9	39.9
16	15.8	02.5	76	75.1	11.9	36	134.3	21.3	96	193.6	30.7	56	252.8	40.0
17	16.8	02.7	77	76.1	12.0	37	135.3	21.4	97	194.6	30.8	57	253.8	40.2
18	17.8	02.8	78	77.0	12.2	38	136.3	21.6	98	195.6	31.0	58	254.8	40.4
19	18.8	03.0	79	78.0	12.4	39	137.3	21.7	99	196.5	31.1	59	255.8	40.5
20	19.8	03.1	80	79.0	12.5	40	138.3	21.9	200	197.5	31.3	60	256.8	40.7
21	20.7	03.3	81	80.0	12.7	141	139.3	22.1	201	198.5	31.4	261	257.8	40.8
22	21.7	03.4	82	81.0	12.8	42	140.3	22.2	02	199.5	31.6	62	258.8	41.0
23	22.7	03.6	83	82.0	13.0	43	141.2	22.4	03	200.5	31.8	63	259.8	41.1
24	23.7	03.8	84	83.0	13.1	44	142.2	22.5	04	201.5	31.9	64	260.7	41.3
25	24.7	03.9	85	84.0	13.3	45	143.2	22.7	05	202.5	32.1	65	261.7	41.5
26	25.7	04.1	86	84.9	13.5	46	144.2	22.8	06	203.5	32.2	66	262.7	41.6
27	26.7	04.2	87	85.9	13.6	47	145.2	23.0	07	204.5	32.4	67	263.7	41.8
28	27.7	04.4	88	86.9	13.8	48	146.2	23.2	08	205.4	32.5	68	264.7	41.9
29	28.6	04.5	89	87.9	13.9	49	147.2	23.3	09	206.4	32.7	69	265.7	42.1
30	29.6	04.7	90	88.9	14.1	50	148.2	23.5	10	207.4	32.9	70	266.7	42.2
31	30.6	04.8	91	89.9	14.2	151	149.1	23.6	211	208.4	33.0	271	267.7	42.4
32	31.6	05.0	92	90.9	14.4	52	150.1	23.8	12	209.4	33.2	72	268.7	42.6
33	32.6	05.2	93	91.9	14.5	53	151.1	23.9	13	210.4	33.3	73	269.6	42.7
34	33.6	05.3	94	92.8	14.7	54	152.1	24.1	14	211.4	33.5	74	270.6	42.9
35	34.6	05.5	95	93.8	14.9	55	153.1	24.2	15	212.4	33.6	75	271.6	43.0
36	35.6	05.6	96	94.8	15.0	56	154.1	24.4	16	213.3	33.8	76	272.6	43.2
37	36.5	05.8	97	95.8	15.2	57	155.1	24.6	17	214.3	33.9	77	273.6	43.3
38	37.5	05.9	98	96.8	15.3	58	156.1	24.7	18	215.3	34.1	78	274.6	43.5
39	38.5	06.1	99	97.8	15.5	59	157.0	24.9	19	216.3	34.3	79	275.6	43.6
40	39.5	06.3	100	98.8	15.6	60	158.0	25.0	20	217.3	34.4	80	276.6	43.8
41	40.5	06.4	101	99.8	15.8	161	159.0	25.2	221	218.3	34.6	281	277.5	44.0
42	41.5	06.6	02	100.7	16.0	62	160.0	25.3	22	219.3	34.7	82	278.5	44.1
43	42.5	06.7	03	101.7	16.1	63	161.0	25.5	23	220.3	34.9	83	279.5	44.3
44	43.5	06.9	04	102.7	16.3	64	162.0	25.7	24	221.2	35.0	84	280.5	44.4
45	44.4	07.0	05	103.7	16.4	65	163.0	25.8	25	222.2	35.2	85	281.5	44.6
46	45.4	07.2	06	104.7	16.6	66	164.0	26.0	26	223.2	35.4	86	282.5	44.7
47	46.4	07.4	07	105.7	16.7	67	164.9	26.1	27	224.2	35.5	87	283.5	44.9
48	47.4	07.5	08	106.7	16.9	68	165.9	26.3	28	225.2	35.7	88	284.5	45.1
49	48.4	07.7	09	107.7	17.1	69	166.9	26.4	29	226.2	35.8	89	285.4	45.2
50	49.4	07.8	10	108.6	17.2	70	167.9	26.6	30	227.2	36.0	90	286.4	45.4
51	50.4	08.0	111	109.6	17.4	171	168.9	26.8	231	228.2	36.1	291	287.4	45.5
52	51.4	08.1	12	110.6	17.5	72	169.9	26.9	32	229.1	36.3	92	288.4	45.7
53	52.3	08.3	13	111.6	17.7	73	170.9	27.1	33	230.1	36.4	93	289.4	45.8
54	53.3	08.4	14	112.6	17.8	74	171.9	27.2	34	231.1	36.6	94	290.4	46.0
55	54.3	08.6	15	113.6	18.0	75	172.8	27.4	35	232.1	36.8	95	291.4	46.1
56	55.3	08.8	16	114.6	18.1	76	173.8	27.5	36	233.1	36.9	96	292.4	46.3
57	56.3	08.9	17	115.6	18.3	77	174.8	27.7	37	234.1	37.1	97	293.3	46.5
58	57.3	09.1	18	116.5	18.5	78	175.8	27.8	38	235.1	37.2	98	294.3	46.6
59	58.3	09.2	19	117.5	18.6	79	176.8	28.0	39	236.1	37.4	99	295.3	46.8
60	59.3	09.4	20	118.5	18.8	80	177.8	28.2	40	237.0	37.5	300	296.3	46.9
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Table II. Difference of Latitude and Departure for 12 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.2	61	59.7	12.7	121	118.4	25.2	181	177.0	37.6	241	235.7	50.1
2	02.0	00.4	62	60.6	12.9	22	119.3	25.4	82	178.0	37.8	42	236.7	50.3
3	02.9	00.6	63	61.6	13.1	23	120.3	25.6	83	179.0	38.0	43	237.7	50.5
4	03.9	00.8	64	62.6	13.3	24	121.3	25.8	84	180.0	38.3	44	238.7	50.7
5	04.9	01.0	65	63.6	13.5	25	122.3	26.0	85	181.0	38.5	45	239.6	50.9
6	05.9	01.2	66	64.6	13.7	26	123.2	26.2	86	181.9	38.7	46	240.6	51.1
7	06.8	01.5	67	65.5	13.9	27	124.2	26.4	87	182.9	38.9	47	241.6	51.4
8	07.8	01.7	68	66.5	14.1	28	125.2	26.6	88	183.9	39.1	48	242.6	51.6
9	08.8	01.9	69	67.5	14.3	29	126.2	26.8	89	184.9	39.3	49	243.6	51.8
10	09.8	02.1	70	68.5	14.6	30	127.2	27.0	90	185.8	39.5	50	244.5	52.0
11	10.8	02.3	71	69.4	14.8	131	128.1	27.2	191	186.8	39.7	251	245.5	52.2
12	11.7	02.5	72	70.4	15.0	32	129.1	27.4	92	187.8	39.9	52	246.5	52.4
13	12.7	02.7	73	71.4	15.2	33	130.1	27.7	93	188.8	40.1	53	247.5	52.6
14	13.7	02.9	74	72.4	15.4	34	131.1	27.9	94	189.8	40.3	54	248.4	52.8
15	14.7	03.1	75	73.4	15.6	35	132.0	28.1	95	190.7	40.5	55	249.4	53.0
16	15.7	03.3	76	74.3	15.8	36	133.0	28.3	96	191.7	40.8	56	250.4	53.2
17	16.6	03.5	77	75.3	16.0	37	134.0	28.5	97	192.7	41.0	57	251.4	53.4
18	17.6	03.7	78	76.3	16.2	38	135.0	28.7	98	193.7	41.2	58	252.4	53.6
19	18.6	04.0	79	77.3	16.4	39	136.0	28.9	99	194.7	41.4	59	253.3	53.8
20	19.6	04.2	80	78.3	16.6	40	136.9	29.1	200	195.6	41.6	60	254.3	54.1
21	20.5	04.4	81	79.2	16.8	141	137.9	29.3	201	196.6	41.8	261	255.3	54.3
22	21.5	04.6	82	80.2	17.0	42	138.9	29.5	02	197.6	42.0	62	256.3	54.5
23	22.5	04.8	83	81.2	17.3	43	139.9	29.7	03	198.6	42.2	63	257.2	54.7
24	23.5	05.0	84	82.2	17.5	44	140.9	29.9	04	199.5	42.4	64	258.2	54.9
25	24.5	05.2	85	83.1	17.7	45	141.8	30.1	05	200.5	42.6	65	259.2	55.1
26	25.4	05.5	86	84.1	17.9	46	142.8	30.4	06	201.5	42.8	66	260.2	55.3
27	26.4	05.6	87	85.1	18.1	47	143.8	30.6	07	202.5	43.0	67	261.2	55.5
28	27.4	05.8	88	86.1	18.3	48	144.8	30.8	08	203.5	43.2	68	262.1	55.7
29	28.4	06.0	89	87.0	18.5	49	145.7	31.0	09	204.4	43.5	69	263.1	55.9
30	29.3	06.2	90	88.0	18.7	50	146.7	31.2	10	205.4	43.7	70	264.1	56.1
31	30.3	06.4	91	89.0	18.9	151	147.7	31.4	211	206.4	43.9	271	265.1	56.3
32	31.3	06.7	92	90.0	19.1	52	148.7	31.6	12	207.4	44.1	72	266.1	56.6
33	32.3	06.9	93	91.0	19.3	53	149.7	31.8	13	208.3	44.3	73	267.0	56.8
34	33.3	07.1	94	91.9	19.5	54	150.6	32.0	14	209.3	44.5	74	268.0	57.0
35	34.2	07.3	95	92.9	19.8	55	151.6	32.2	15	210.3	44.7	75	269.0	57.2
36	35.2	07.5	96	93.9	20.0	56	152.6	32.4	16	211.3	44.9	76	270.0	57.4
37	36.2	07.7	97	94.9	20.2	57	153.6	32.6	17	212.3	45.1	77	270.9	57.6
38	37.2	07.9	98	95.9	20.4	58	154.5	32.8	18	213.2	45.3	78	271.9	57.8
39	38.1	08.1	99	96.8	20.6	59	155.5	33.1	19	214.2	45.5	79	272.9	58.0
40	39.1	08.3	100	97.8	20.8	60	156.5	33.3	20	215.2	45.7	80	273.9	58.2
41	40.1	08.5	101	98.8	21.0	161	157.5	33.5	221	216.2	45.9	281	274.9	58.4
42	41.1	08.7	02	99.8	21.2	62	158.5	33.7	22	217.1	46.2	82	275.8	58.6
43	42.1	08.9	03	100.7	21.4	63	159.4	33.9	23	218.1	46.4	83	276.8	58.8
44	43.0	09.1	04	101.7	21.6	64	160.4	34.1	24	219.1	46.6	84	277.8	59.0
45	44.0	09.4	05	102.7	21.8	65	161.4	34.3	25	220.1	46.8	85	278.8	59.3
46	45.0	09.6	06	103.7	22.0	66	162.4	34.5	26	221.1	47.0	86	279.8	59.5
47	46.0	09.8	07	104.7	22.2	67	163.4	34.7	27	222.0	47.2	87	280.7	59.7
48	47.0	10.0	08	105.6	22.5	68	164.3	34.9	28	223.0	47.4	88	281.7	59.9
49	47.9	10.2	09	106.6	22.7	69	165.3	35.1	29	224.0	47.6	89	282.7	60.1
50	48.9	10.4	10	107.6	22.9	70	166.3	35.3	30	225.0	47.8	90	283.7	60.3
51	49.9	10.6	111	108.6	23.1	171	167.3	35.6	231	226.0	48.0	291	284.6	60.5
52	50.9	10.8	12	109.6	23.3	72	168.2	35.8	32	226.9	48.2	92	285.6	60.7
53	51.8	11.0	13	110.5	23.5	73	169.2	36.0	33	227.9	48.4	93	286.6	60.9
54	52.8	11.2	14	111.5	23.7	74	170.2	36.2	34	228.9	48.7	94	287.6	61.1
55	53.8	11.4	15	112.5	23.9	75	171.2	36.4	35	229.9	48.9	95	288.6	61.3
56	54.8	11.6	16	113.5	24.1	76	172.2	36.6	36	230.8	49.1	96	289.5	61.5
57	55.8	11.9	17	114.4	24.3	77	173.1	36.8	37	231.8	49.3	97	290.5	61.7
58	56.7	12.1	18	115.4	24.5	78	174.1	37.0	38	232.8	49.5	98	291.5	62.0
59	57.7	12.3	19	116.4	24.7	79	175.1	37.2	39	233.8	49.7	99	292.5	62.2
60	58.7	12.5	20	117.4	24.9	80	176.1	37.4	40	234.8	49.9	300	293.4	62.4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 78 Degrees.

TABLE II. Difference of Latitude and Departure for 11 Degrees.

Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	01.0	00.2	61	59.9	11.6	121	118.8	23.1	181	177.7	34.5	241	236.6	46.0
2	02.0	00.4	62	60.9	11.8	22	119.8	23.3	82	178.7	34.7	42	237.6	46.2
3	02.9	00.6	63	61.8	12.0	23	120.7	23.5	83	179.6	34.9	43	238.5	46.4
4	03.9	00.8	64	62.8	12.2	24	121.7	23.7	84	180.6	35.1	44	239.5	46.6
5	04.9	01.0	65	63.8	12.4	25	122.7	23.9	85	181.6	35.3	45	240.5	46.7
6	05.9	01.1	66	64.8	12.6	26	123.7	24.0	86	182.6	35.5	46	241.5	46.9
7	06.9	01.3	67	65.8	12.8	27	124.7	24.2	87	183.6	35.7	47	242.5	47.1
8	07.9	01.5	68	66.8	13.0	28	125.6	24.4	88	184.5	35.9	48	243.4	47.3
9	08.8	01.7	69	67.7	13.2	29	126.6	24.6	89	185.5	36.1	49	244.4	47.5
10	09.8	01.9	70	68.7	13.4	30	127.6	24.8	90	186.5	36.3	50	245.4	47.7
11	10.8	02.1	71	69.7	13.5	131	128.6	25.0	191	187.5	36.4	251	246.4	47.9
12	11.8	02.3	72	70.7	13.7	32	129.6	25.2	92	188.5	36.6	52	247.4	48.1
13	12.8	02.5	73	71.7	13.9	33	130.6	25.4	93	189.5	36.8	53	248.4	48.3
14	13.7	02.7	74	72.6	14.1	34	131.5	25.6	94	190.4	37.0	54	249.3	48.5
15	14.7	02.9	75	73.6	14.3	35	132.5	25.8	95	191.4	37.2	55	250.3	48.7
16	15.7	03.1	76	74.6	14.5	36	133.5	26.0	96	192.4	37.4	56	251.3	48.8
17	16.7	03.2	77	75.6	14.7	37	134.5	26.1	97	193.4	37.6	57	252.3	49.0
18	17.7	03.4	78	76.6	14.9	38	135.5	26.3	98	194.4	37.8	58	253.3	49.2
19	18.7	03.6	79	77.5	15.1	39	136.4	26.5	99	195.3	38.0	59	254.2	49.4
20	19.6	03.8	80	78.5	15.3	40	137.4	26.7	200	196.3	38.2	60	255.2	49.6
21	20.6	04.0	81	79.5	15.5	141	138.4	26.9	201	197.3	38.4	261	256.2	49.8
22	21.6	04.2	82	80.5	15.6	42	139.4	27.1	02	198.3	38.5	62	257.2	50.0
23	22.6	04.4	83	81.5	15.8	43	140.4	27.3	03	199.3	38.7	63	258.2	50.2
24	23.6	04.6	84	82.5	16.0	44	141.4	27.5	04	200.3	38.9	64	259.1	50.4
25	24.5	04.8	85	83.4	16.2	45	142.3	27.7	05	201.2	39.1	65	260.1	50.6
26	25.5	05.0	86	84.4	16.4	46	143.3	27.9	06	202.2	39.3	66	261.1	50.8
27	26.5	05.2	87	85.4	16.6	47	144.3	28.0	07	203.2	39.5	67	262.1	50.9
28	27.5	05.3	88	86.4	16.8	48	145.3	28.2	08	204.2	39.7	68	263.1	51.1
29	28.5	05.5	89	87.4	17.0	49	146.3	28.4	09	205.2	39.9	69	264.1	51.3
30	29.4	05.7	90	88.3	17.2	50	147.2	28.6	10	206.1	40.1	70	265.0	51.5
31	30.4	05.9	91	89.3	17.4	151	148.2	28.8	211	207.1	40.3	271	266.0	51.7
32	31.4	06.1	92	90.3	17.6	52	149.2	29.0	12	208.1	40.4	72	267.0	51.9
33	32.4	06.3	93	91.3	17.7	53	150.2	29.2	13	209.1	40.5	73	268.0	52.1
34	33.4	06.5	94	92.3	17.9	54	151.2	29.4	14	210.1	40.8	74	269.0	52.3
35	34.4	06.7	95	93.3	18.1	55	152.2	29.6	15	211.0	41.0	75	269.9	52.5
36	35.3	06.9	96	94.2	18.3	56	153.1	29.8	16	212.0	41.2	76	270.9	52.7
37	36.3	07.1	97	95.2	18.5	57	154.1	30.0	17	213.0	41.4	77	271.9	52.9
38	37.3	07.3	98	96.2	18.7	58	155.1	30.1	18	214.0	41.6	78	272.9	53.0
39	38.3	07.4	99	97.2	18.9	59	156.1	30.3	19	215.0	41.8	79	273.9	53.2
40	39.3	07.6	100	98.2	19.1	60	157.1	30.5	20	216.0	42.0	80	274.8	53.4
41	40.2	07.8	101	99.1	19.3	161	158.0	30.7	221	216.9	42.2	281	275.8	53.6
42	41.2	08.0	02	100.1	19.5	62	159.0	30.9	22	217.9	42.4	82	276.8	53.8
43	42.2	08.2	03	101.1	19.7	63	160.0	31.1	23	218.9	42.6	83	277.8	54.0
44	43.2	08.4	04	102.1	19.8	64	161.0	31.3	24	219.9	42.7	84	278.8	54.2
45	44.2	08.6	05	103.1	20.0	65	162.0	31.5	25	220.9	42.9	85	279.8	54.4
46	45.2	08.8	06	104.1	20.2	66	163.0	31.7	26	221.8	43.1	86	280.7	54.6
47	46.1	09.0	07	105.0	20.4	67	163.9	31.9	27	222.8	43.3	87	281.7	54.8
48	47.1	09.2	08	106.0	20.6	68	164.9	32.1	28	223.8	43.5	88	282.7	55.0
49	48.1	09.3	09	107.0	20.8	69	165.9	32.2	29	224.8	43.7	89	283.7	55.1
50	49.1	09.5	10	108.0	21.0	70	166.9	32.4	30	225.8	43.9	90	284.7	55.3
51	50.1	09.7	111	109.0	21.2	171	167.9	32.6	231	226.8	44.1	291	285.7	55.5
52	51.0	09.9	12	109.9	21.4	72	168.8	32.8	32	227.7	44.3	92	286.6	55.7
53	52.0	10.1	13	110.9	21.6	73	169.8	33.0	33	228.7	44.5	93	287.6	55.9
54	53.0	10.3	14	111.9	21.8	74	170.8	33.2	34	229.7	44.6	94	288.6	56.1
55	54.0	10.5	15	112.9	21.9	75	171.8	33.4	35	230.7	44.8	95	289.6	56.3
56	55.0	10.7	16	113.9	22.1	76	172.8	33.6	36	231.7	45.0	96	290.6	56.5
57	56.0	10.9	17	114.9	22.3	77	173.7	33.8	37	232.6	45.2	97	291.5	56.7
58	56.9	11.1	18	115.8	22.5	78	174.7	34.0	38	233.6	45.4	98	292.5	56.9
59	57.9	11.3	19	116.8	22.7	79	175.7	34.2	39	234.6	45.6	99	293.5	57.1
60	58.9	11.4	20	117.8	22.9	80	176.7	34.3	40	235.6	45.8	300	294.5	57.2
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

D d 2 for 79 Degrees.

Table II. Difference of Latitude and Departure for 14 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.2	61	59.2	14.8	121	117.4	29.3	181	175.6	43.8	241	233.8	58.3
2	01.9	00.5	62	60.2	15.0	22	118.4	29.5	82	176.6	44.0	42	234.8	58.5
3	02.9	00.7	63	61.1	15.2	23	119.3	29.8	83	177.6	44.3	43	235.8	58.8
4	03.9	01.0	64	62.1	15.5	24	120.3	30.0	84	178.5	44.5	44	236.8	59.0
5	04.9	01.2	65	63.1	15.7	25	121.3	30.2	85	179.5	44.8	45	237.7	59.3
6	05.8	01.5	66	64.0	16.0	26	122.3	30.5	86	180.5	45.0	46	238.7	59.5
7	06.8	01.7	67	65.0	16.2	27	123.2	30.7	87	181.4	45.2	47	239.7	59.8
8	07.8	01.9	68	66.0	16.5	28	124.2	31.0	88	182.4	45.5	48	240.6	60.0
9	08.7	02.2	69	67.0	16.7	29	125.2	31.2	89	183.4	45.7	49	241.6	60.2
10	09.7	02.4	70	67.9	16.9	30	126.1	31.4	90	184.4	46.0	50	242.6	60.5
11	10.7	02.7	71	68.9	17.2	131	127.1	31.7	191	185.3	46.2	251	243.5	60.7
12	11.6	02.9	72	69.9	17.4	32	128.1	31.9	92	186.3	46.4	52	244.5	61.0
13	12.6	03.1	73	70.8	17.7	33	129.0	32.2	93	187.3	46.7	53	245.5	61.2
14	13.6	03.4	74	71.8	17.9	34	130.0	32.4	94	188.2	46.9	54	246.5	61.4
15	14.6	03.6	75	72.8	18.1	35	131.0	32.7	95	189.2	47.2	55	247.4	61.7
16	15.5	03.9	76	73.7	18.4	36	132.0	32.9	96	190.2	47.4	56	248.4	61.9
17	16.5	04.1	77	74.7	18.6	37	132.9	33.1	97	191.1	47.7	57	249.4	62.2
18	17.5	04.4	78	75.7	18.9	38	133.9	33.4	98	192.1	47.9	58	250.3	62.4
19	18.4	04.6	79	76.7	19.1	39	134.9	33.6	99	193.1	48.1	59	251.3	62.7
20	19.4	04.8	80	77.6	19.4	40	135.8	33.9	200	194.1	48.4	60	252.3	62.9
21	20.4	05.1	81	78.6	19.6	141	136.8	34.1	201	195.0	48.6	261	253.2	63.1
22	21.3	05.3	82	79.6	19.8	42	137.8	34.4	02	196.0	48.9	62	254.2	63.4
23	22.3	05.6	83	80.5	20.1	43	138.8	34.6	03	197.0	49.1	63	255.2	63.6
24	23.3	05.8	84	81.5	20.3	44	139.7	34.8	04	197.9	49.4	64	256.2	63.9
25	24.3	06.0	85	82.5	20.6	45	140.7	35.1	05	198.9	49.6	65	257.1	64.1
26	25.2	06.3	86	83.4	20.8	46	141.7	35.3	06	199.9	49.8	66	258.1	64.4
27	26.2	06.5	87	84.4	21.0	47	142.6	35.6	07	200.9	50.1	67	259.1	64.6
28	27.2	06.8	88	85.4	21.3	48	143.6	35.8	08	201.8	50.3	68	260.0	64.8
29	28.1	07.0	89	86.4	21.5	49	144.6	36.0	09	202.8	50.6	69	261.0	65.1
30	29.1	07.3	90	87.3	21.8	50	145.5	36.3	10	203.8	50.8	70	262.0	65.3
31	30.1	07.5	91	88.3	22.0	151	146.5	36.5	211	204.7	51.0	271	263.0	65.6
32	31.0	07.7	92	89.3	22.3	52	147.5	36.8	12	205.7	51.3	72	263.9	65.8
33	32.0	08.0	93	90.2	22.5	53	148.5	37.0	13	206.7	51.5	73	264.9	66.0
34	33.0	08.2	94	91.2	22.7	54	149.4	37.3	14	207.6	51.8	74	265.9	66.3
35	34.0	08.5	95	92.2	23.0	55	150.4	37.5	15	208.6	52.0	75	266.8	66.5
36	34.9	08.7	96	93.1	23.2	56	151.4	37.7	16	209.6	52.3	76	267.8	66.8
37	35.9	09.0	97	94.1	23.5	57	152.3	38.0	17	210.6	52.5	77	268.8	67.0
38	36.9	09.2	98	95.1	23.7	58	153.3	38.2	18	211.5	52.7	78	269.7	67.3
39	37.8	09.4	99	96.1	24.0	59	154.3	38.5	19	212.5	53.0	79	270.7	67.5
40	38.8	09.7	100	97.0	24.2	60	155.2	38.7	20	213.5	53.2	80	271.7	67.7
41	39.8	09.9	101	98.0	24.4	161	156.2	38.9	221	214.4	53.5	281	272.7	68.0
42	40.8	10.2	02	99.0	24.7	62	157.2	39.2	22	215.4	53.7	82	273.6	68.2
43	41.7	10.4	03	99.9	24.9	63	158.2	39.4	23	216.4	53.9	83	274.6	68.5
44	42.7	10.6	04	100.9	25.2	64	159.1	39.7	24	217.3	54.2	84	275.6	68.7
45	43.7	10.9	05	101.9	25.4	65	160.1	39.9	25	218.3	54.4	85	276.5	68.9
46	44.6	11.1	06	102.9	25.6	66	161.1	40.2	26	219.3	54.7	86	277.5	69.2
47	45.6	11.4	07	103.8	25.9	67	162.0	40.4	27	220.3	54.9	87	278.5	69.4
48	46.6	11.6	08	104.8	26.1	68	163.0	40.6	28	221.2	55.2	88	279.4	69.7
49	47.5	11.9	09	105.8	26.4	69	164.0	40.9	29	222.2	55.4	89	280.4	69.9
50	48.5	12.1	10	106.7	26.6	70	164.9	41.1	30	223.2	55.6	90	281.4	70.2
51	49.5	12.3	111	107.7	26.9	171	165.9	41.4	231	224.1	55.9	291	282.4	70.4
52	50.5	12.6	12	108.7	27.1	72	166.9	41.6	32	225.1	56.1	92	283.3	70.6
53	51.4	12.8	13	109.6	27.3	73	167.9	41.9	33	226.1	56.4	93	284.3	70.9
54	52.4	13.1	14	110.6	27.6	74	168.8	42.1	34	227.0	56.6	94	285.3	71.1
55	53.4	13.3	15	111.6	27.8	75	169.8	42.3	35	228.0	56.9	95	286.2	71.4
56	54.3	13.5	16	112.6	28.1	76	170.8	42.6	36	229.0	57.1	96	287.2	71.6
57	55.3	13.8	17	113.5	28.3	77	171.7	42.8	37	230.0	57.3	97	288.2	71.9
58	56.3	14.0	18	114.5	28.5	78	172.7	43.1	38	230.9	57.6	98	289.1	72.1
59	57.2	14.3	19	115.5	28.8	79	173.7	43.3	39	231.9	57.8	99	290.1	72.3
60	58.2	14.5	20	116.4	29.0	80	174.7	43.5	40	232.9	58.1	300	291.1	72.6
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 76 Degrees.

Table II. Difference of Latitude and Departure for 13 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.2	61	59.4	13.7	121	117.9	27.2	181	176.4	40.7	241	234.8	54.2
2	01.9	00.4	62	60.4	13.9	22	118.9	27.4	82	177.3	40.9	42	235.8	54.4
3	02.9	00.7	63	61.4	14.2	23	119.8	27.7	83	178.3	41.2	43	236.8	54.7
4	03.9	00.9	64	62.4	14.4	24	120.8	27.9	84	179.3	41.4	44	237.7	54.9
5	04.9	01.1	65	63.3	14.6	25	121.8	28.1	85	180.3	41.6	45	238.7	55.1
6	05.8	01.3	66	64.3	14.8	26	122.8	28.3	86	181.2	41.8	46	239.7	55.3
7	06.8	01.6	67	65.3	15.1	27	123.7	28.6	87	182.2	42.1	47	240.7	55.6
8	07.8	01.8	68	66.3	15.3	28	124.7	28.8	88	183.2	42.3	48	241.6	55.8
9	08.8	02.0	69	67.2	15.5	29	125.7	29.0	89	184.2	42.5	49	242.6	56.0
10	09.7	02.2	70	68.2	15.7	30	126.7	29.2	90	185.1	42.7	50	243.6	56.2
11	10.7	02.5	71	69.2	16.0	131	127.6	29.5	191	186.1	43.0	251	244.6	56.5
12	11.7	02.7	72	70.2	16.2	32	128.6	29.7	92	187.1	43.2	52	245.5	56.7
13	12.7	02.9	73	71.1	16.4	33	129.6	29.9	93	188.1	43.4	53	246.5	56.9
14	13.6	03.1	74	72.1	16.6	34	130.6	30.1	94	189.0	43.6	54	247.5	57.1
15	14.6	03.4	75	73.1	16.9	35	131.5	30.4	95	190.0	43.9	55	248.5	57.4
16	15.6	03.6	76	74.1	17.1	36	132.5	30.6	96	191.0	44.1	56	249.4	57.6
17	16.6	03.8	77	75.0	17.3	37	133.5	30.8	97	192.0	44.3	57	250.4	57.8
18	17.5	04.0	78	76.0	17.5	38	134.5	31.0	98	192.9	44.5	58	251.4	58.0
19	18.5	04.3	79	77.0	17.8	39	135.4	31.3	99	193.9	44.8	59	252.4	58.3
20	19.5	04.5	80	78.0	18.0	40	136.4	31.5	200	194.9	45.0	60	253.3	58.5
21	20.5	04.7	81	78.9	18.2	141	137.4	31.7	201	195.8	45.2	261	254.3	58.7
22	21.4	04.9	82	79.9	18.4	42	138.4	31.9	02	196.8	45.4	62	255.3	58.9
23	22.4	05.2	83	80.9	18.7	43	139.3	32.2	03	197.8	45.7	63	256.3	59.2
24	23.4	05.4	84	81.8	18.9	44	140.3	32.4	04	198.8	45.9	64	257.2	59.4
25	24.4	05.6	85	82.8	19.1	45	141.3	32.6	05	199.7	46.1	65	258.2	59.6
26	25.3	05.8	86	83.8	19.3	46	142.3	32.8	06	200.7	46.3	66	259.2	59.8
27	26.3	06.1	87	84.8	19.6	47	143.2	33.1	07	201.7	46.6	67	260.2	60.1
28	27.3	06.3	88	85.7	19.8	48	144.2	33.3	08	202.7	46.8	68	261.1	60.3
29	28.3	06.5	89	86.7	20.0	49	145.2	33.5	09	203.6	47.0	69	262.1	60.5
30	29.2	06.7	90	87.7	20.2	50	146.2	33.7	10	204.6	47.2	70	263.1	60.7
31	30.2	07.0	91	88.7	20.5	151	147.1	34.0	211	205.6	47.5	271	264.1	61.0
32	31.2	07.2	92	89.6	20.7	52	148.1	34.2	12	206.6	47.7	72	265.0	61.2
33	32.2	07.4	93	90.6	20.9	53	149.1	34.4	13	207.5	47.9	73	266.0	61.4
34	33.1	07.6	94	91.6	21.1	54	150.1	34.6	14	208.5	48.1	74	267.0	61.6
35	34.1	07.9	95	92.6	21.4	55	151.0	34.9	15	209.5	48.4	75	268.0	61.9
36	35.1	08.1	96	93.5	21.6	56	152.0	35.1	16	210.5	48.6	76	268.9	62.1
37	36.1	08.3	97	94.5	21.8	57	153.0	35.3	17	211.4	48.8	77	269.9	62.3
38	37.0	08.5	98	95.5	22.0	58	154.0	35.5	18	212.4	49.0	78	270.9	62.5
39	38.0	08.8	99	96.5	22.3	59	154.9	35.8	19	213.4	49.3	79	271.9	62.8
40	39.0	09.0	100	97.4	22.5	60	155.9	36.0	20	214.4	49.5	80	272.8	63.0
41	39.9	09.2	101	98.4	22.7	161	156.9	36.2	221	215.3	49.7	281	273.8	63.2
42	40.9	09.4	02	99.4	22.9	62	157.8	36.4	22	216.3	49.9	82	274.8	63.4
43	41.9	09.7	03	100.4	23.2	63	158.8	36.7	23	217.3	50.2	83	275.7	63.7
44	42.9	09.9	04	101.3	23.4	64	159.8	36.9	24	218.3	50.4	84	276.7	63.9
45	43.8	10.1	05	102.3	23.6	65	160.8	37.1	25	219.2	50.6	85	277.7	64.1
46	44.8	10.3	06	103.3	23.8	66	161.7	37.3	26	220.2	50.8	86	278.7	64.3
47	45.8	10.6	07	104.3	24.1	67	162.7	37.6	27	221.2	51.1	87	279.6	64.6
48	46.8	10.8	08	105.2	24.3	68	163.7	37.8	28	222.2	51.3	88	280.6	64.8
49	47.7	11.0	09	106.2	24.5	69	164.7	38.0	29	223.1	51.5	89	281.6	65.0
50	48.7	11.2	10	107.2	24.7	70	165.6	38.2	30	224.1	51.7	90	282.6	65.2
51	49.7	11.5	111	108.2	25.0	171	166.6	38.5	231	225.1	52.0	291	283.5	65.5
52	50.7	11.7	12	109.1	25.2	72	167.6	38.7	32	226.1	52.2	92	284.5	65.7
53	51.6	11.9	13	110.1	25.4	73	168.6	38.9	33	227.0	52.4	93	285.5	65.9
54	52.6	12.1	14	111.1	25.6	74	169.5	39.1	34	228.0	52.6	94	286.5	66.1
55	53.6	12.4	15	112.1	25.9	75	170.5	39.4	35	229.0	52.9	95	287.4	66.4
56	54.6	12.6	16	113.0	26.1	76	171.5	39.6	36	230.0	53.1	96	288.4	66.6
57	55.5	12.8	17	114.0	26.3	77	172.5	39.8	37	230.9	53.3	97	289.4	66.8
58	56.5	13.0	18	115.0	26.5	78	173.4	40.0	38	231.9	53.5	98	290.4	67.0
59	57.5	13.3	19	116.0	26.8	79	174.4	40.3	39	232.9	53.8	99	291.3	67.3
60	58.5	13.5	20	116.9	27.0	80	175.4	40.5	40	233.8	54.0	300	292.3	67.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 77 Degrees.

Table II. Difference of Latitude and Departure for 16 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.3	61	58.6	16.8	121	116.3	33.4	181	174.0	49.9	241	231.7	66.4
2	01.9	00.6	62	59.6	17.1	22	117.3	33.6	82	174.9	50.2	42	232.6	66.7
3	02.9	00.8	63	60.6	17.4	23	118.2	33.9	83	175.9	50.4	43	233.6	67.0
4	03.8	01.1	64	61.5	17.6	24	119.2	34.2	84	176.9	50.7	44	234.5	67.3
5	04.8	01.4	65	62.5	17.9	25	120.2	34.5	85	177.8	51.0	45	235.5	67.5
6	05.8	01.7	66	63.4	18.2	26	121.1	34.7	86	178.8	51.3	46	236.5	67.8
7	06.7	01.9	67	64.4	18.5	27	122.1	35.0	87	179.8	51.5	47	237.4	68.1
8	07.7	02.2	68	65.4	18.7	28	123.0	35.3	88	180.7	51.8	48	238.4	68.4
9	08.7	02.5	69	66.3	19.0	29	124.0	35.6	89	181.7	52.1	49	239.4	68.6
10	09.6	02.8	70	67.3	19.3	30	125.0	35.8	90	182.6	52.4	50	240.3	68.9
11	10.6	03.0	71	68.2	19.6	131	125.9	36.1	191	183.6	52.6	251	241.3	69.2
12	11.5	03.3	72	69.2	19.8	32	126.9	36.4	92	184.6	52.9	52	242.2	69.5
13	12.5	03.6	73	70.2	20.1	33	127.8	36.7	93	185.5	53.2	53	243.2	69.7
14	13.5	03.9	74	71.1	20.4	34	128.8	36.9	94	186.5	53.5	54	244.2	70.0
15	14.4	04.1	75	72.1	20.7	35	129.8	37.2	95	187.4	53.7	55	245.1	70.3
16	15.4	04.4	76	73.1	20.9	36	130.7	37.5	96	188.4	54.0	56	246.1	70.6
17	16.3	04.7	77	74.0	21.2	37	131.7	37.8	97	189.4	54.3	57	247.0	70.8
18	17.3	05.0	78	75.0	21.5	38	132.7	38.0	98	190.3	54.6	58	248.0	71.1
19	18.3	05.2	79	75.9	21.8	39	133.6	38.3	99	191.3	54.9	59	249.0	71.4
20	19.2	05.5	80	76.9	22.1	40	134.6	38.6	200	192.3	55.1	60	249.9	71.7
21	20.2	05.8	81	77.9	22.3	141	135.5	38.9	201	193.2	55.4	261	250.9	71.9
22	21.1	06.1	82	78.8	22.6	42	136.5	39.1	02	194.2	55.7	62	251.9	72.2
23	22.1	06.3	83	79.8	22.9	43	137.5	39.4	03	195.1	56.0	63	252.8	72.5
24	23.0	06.6	84	80.7	23.2	44	138.4	39.7	04	196.1	56.2	64	253.8	72.8
25	24.0	06.9	85	81.7	23.4	45	139.4	40.0	05	197.1	56.5	65	254.7	73.0
26	25.0	07.2	86	82.7	23.7	46	140.3	40.2	06	198.0	56.8	66	255.7	73.3
27	26.0	07.4	87	83.6	24.0	47	141.3	40.5	07	199.0	57.1	67	256.7	73.6
28	26.9	07.7	88	84.6	24.3	48	142.3	40.8	08	199.9	57.3	68	257.6	73.9
29	27.9	08.0	89	85.6	24.5	49	143.2	41.1	09	200.9	57.6	69	258.6	74.1
30	28.8	08.3	90	86.5	24.8	50	144.2	41.3	10	201.9	57.9	70	259.5	74.4
31	29.8	08.5	91	87.5	25.1	151	145.2	41.6	211	202.8	58.2	271	260.5	74.7
32	30.8	08.8	92	88.4	25.4	52	146.1	41.9	12	203.8	58.4	72	261.5	75.0
33	31.7	09.1	93	89.4	25.6	53	147.1	42.2	13	204.7	58.7	73	262.4	75.2
34	32.7	09.4	94	90.4	25.9	54	148.0	42.4	14	205.7	59.0	74	263.4	75.5
35	33.6	09.6	95	91.3	26.2	55	149.0	42.7	15	206.7	59.3	75	264.3	75.8
36	34.6	09.9	96	92.3	26.5	56	150.0	43.0	16	207.6	59.5	76	265.3	76.1
37	35.6	10.2	97	93.2	26.7	57	250.9	43.3	17	208.6	59.8	77	266.3	76.4
38	36.5	10.5	98	94.2	27.0	58	151.9	43.6	18	209.6	60.1	78	267.2	76.6
39	37.5	10.7	99	95.2	27.3	59	152.8	43.8	19	210.5	60.4	79	268.2	76.9
40	38.5	11.0	100	96.1	27.6	60	153.8	44.1	20	211.5	60.6	80	269.2	77.2
41	39.4	11.3	101	97.1	27.8	161	154.8	44.4	221	212.4	60.9	281	270.1	77.5
42	40.4	11.6	02	98.0	28.1	62	155.7	44.7	22	213.4	61.2	82	271.1	77.7
43	41.3	11.9	03	99.0	28.4	63	156.7	44.9	23	214.4	61.5	83	272.0	78.0
44	42.3	12.1	04	100.0	28.7	64	157.6	45.2	24	215.3	61.7	84	273.0	78.3
45	43.3	12.4	05	100.9	28.9	65	158.6	45.5	25	216.3	62.0	85	274.0	78.6
46	44.2	12.7	06	101.9	29.2	66	159.6	45.8	26	217.2	62.3	86	274.9	78.8
47	45.2	13.0	07	102.9	29.5	67	160.5	46.0	27	218.2	62.6	87	275.9	79.1
48	46.1	13.2	08	103.8	29.8	68	161.5	46.3	28	219.2	62.8	88	276.8	79.4
49	47.1	13.5	09	104.8	30.0	69	162.5	46.6	29	220.1	63.1	89	277.8	79.7
50	48.1	13.8	10	105.7	30.3	70	163.4	46.9	30	221.1	63.4	90	278.8	79.9
51	49.0	14.1	111	106.7	30.6	171	164.4	47.1	231	222.1	63.7	291	279.7	80.2
52	50.0	14.3	12	107.7	30.9	72	165.3	47.4	32	223.0	63.9	92	280.7	80.5
53	50.9	14.6	13	108.6	31.1	73	166.3	47.7	33	224.0	64.2	93	281.6	80.8
54	51.9	14.9	14	109.6	31.4	74	167.3	48.0	34	224.9	64.5	94	282.6	81.0
55	52.9	15.2	15	110.5	31.7	75	168.2	48.2	35	225.9	64.8	95	283.6	81.3
56	53.8	15.4	16	111.5	32.0	76	169.2	48.5	36	226.9	65.1	96	284.5	81.6
57	54.8	15.7	17	112.5	32.2	77	170.1	48.8	37	227.8	65.3	97	285.5	81.9
58	55.8	16.0	18	113.4	32.5	78	171.1	49.1	38	228.8	65.6	98	286.5	82.1
59	56.7	16.3	19	114.4	32.8	79	172.1	49.3	39	229.7	65.9	99	287.4	82.4
60	57.7	16.5	20	115.4	33.1	80	173.0	49.6	40	230.7	66.2	300	288.4	82.7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 74 Degrees.

Table II. Difference of Latitude and Departure for 15 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.3	61	58.9	15.8	121	116.9	31.3	181	174.8	46.8	241	232.8	62.4
2	01.9	00.5	62	59.9	16.0	22	117.8	31.6	82	175.8	47.1	42	233.8	62.6
3	02.9	00.8	63	60.6	16.3	23	118.8	31.8	83	176.8	47.4	43	234.7	62.9
4	03.9	01.0	64	61.8	16.6	24	119.8	32.1	84	177.7	47.6	44	235.7	63.2
5	04.8	01.3	65	62.8	16.8	25	120.7	32.4	85	178.7	47.9	45	236.7	63.4
6	05.8	01.6	66	63.8	17.1	26	121.7	32.6	86	179.7	48.1	46	237.6	63.7
7	06.8	01.8	67	64.7	17.3	27	122.7	32.9	87	180.6	48.4	47	238.6	63.9
8	07.7	02.1	68	65.4	17.6	28	123.6	33.1	88	181.6	48.7	48	239.5	64.2
9	08.7	02.3	69	66.6	17.9	29	124.6	33.4	89	182.6	48.9	49	240.5	64.4
10	09.7	02.6	70	67.6	18.1	30	125.6	33.6	90	183.5	49.2	50	241.5	64.7
11	10.6	02.8	71	68.6	18.4	131	126.5	33.9	191	184.5	49.4	251	242.4	65.0
12	11.6	03.1	72	69.5	18.6	32	127.5	34.2	92	185.5	49.7	52	243.4	65.2
13	12.6	03.4	73	70.5	18.9	33	128.5	34.4	93	186.4	50.0	53	244.4	65.5
14	13.5	03.6	74	71.5	19.2	34	129.4	34.7	94	187.4	50.2	54	245.3	65.7
15	14.5	03.9	75	72.4	19.4	35	130.4	34.9	95	188.4	50.5	55	246.3	66.0
16	15.5	04.1	76	73.4	19.7	36	131.4	35.2	96	189.3	50.7	56	247.3	66.3
17	16.4	04.4	77	74.4	19.9	37	132.3	35.5	97	190.3	51.0	57	248.2	66.5
18	17.4	04.7	78	75.3	20.2	38	133.3	35.7	98	191.3	51.2	58	249.2	66.8
19	18.4	04.9	79	76.3	20.4	39	134.3	36.0	99	192.2	51.5	59	250.2	67.0
20	19.3	05.2	80	77.3	20.7	40	135.2	36.2	200	193.2	51.8	60	251.1	67.3
21	20.3	05.4	81	78.2	21.0	141	136.2	36.5	201	194.2	52.0	261	252.1	67.6
22	21.2	05.7	82	79.2	21.2	42	137.2	36.8	02	195.1	52.3	62	253.1	67.8
23	22.2	06.0	83	80.2	21.5	43	138.1	37.0	03	196.1	52.5	63	254.0	68.1
24	23.2	06.2	84	81.1	21.7	44	139.1	37.3	04	197.0	52.8	64	255.0	68.3
25	24.1	06.5	85	82.1	22.0	45	140.1	37.5	05	198.0	53.1	65	256.0	68.6
26	25.1	06.7	86	83.1	22.3	46	141.0	37.8	06	199.0	53.3	66	256.9	68.8
27	26.1	07.0	87	84.0	22.5	47	142.0	38.0	07	199.9	53.6	67	257.9	69.1
28	27.0	07.2	88	85.0	22.8	48	143.0	38.3	08	200.9	53.8	68	258.9	69.4
29	28.0	07.5	89	86.0	23.0	49	143.9	38.6	09	201.9	54.1	69	259.8	69.6
30	29.0	07.8	90	86.9	23.3	50	144.9	38.8	10	202.8	54.4	70	260.8	69.9
31	29.9	08.0	91	87.9	23.6	151	145.9	39.1	211	203.8	54.6	271	261.8	70.1
32	30.9	08.3	92	88.9	23.8	52	146.8	39.3	12	204.8	54.9	72	262.7	70.4
33	31.9	08.5	93	89.8	24.1	53	147.8	39.6	13	205.7	55.1	73	263.7	70.7
34	32.8	08.8	94	90.8	24.3	54	148.8	39.9	14	206.7	55.4	74	264.7	70.9
35	33.8	09.1	95	91.8	24.6	55	149.7	40.1	15	207.7	55.6	75	265.6	71.2
36	34.8	09.3	96	92.7	24.8	56	150.7	40.4	16	208.6	55.9	76	266.6	71.4
37	35.7	09.6	97	93.7	25.1	57	151.7	40.6	17	209.6	56.2	77	267.6	71.7
38	36.7	09.8	98	94.7	25.4	58	152.6	40.9	18	210.6	56.4	78	268.5	72.0
39	37.7	10.1	99	95.6	25.6	59	153.6	41.2	19	211.5	56.7	79	269.5	72.2
40	38.6	10.4	100	96.6	25.9	60	154.5	41.4	20	212.5	56.9	80	270.5	72.5
41	39.6	10.6	101	97.6	26.1	161	155.5	41.7	221	213.5	57.2	281	271.4	72.7
42	40.6	10.9	02	98.5	26.4	62	156.5	41.9	22	214.4	57.5	82	272.4	73.0
43	41.5	11.1	03	99.5	26.7	63	157.4	42.2	23	215.4	57.7	83	273.4	73.2
44	42.5	11.4	04	100.5	26.9	64	158.4	42.4	24	216.4	58.0	84	274.3	73.5
45	43.5	11.6	05	101.4	27.2	65	159.4	42.7	25	217.3	58.2	85	275.3	73.8
46	44.4	11.9	06	102.4	27.4	66	160.3	43.0	26	218.3	58.5	86	276.3	74.0
47	45.4	12.2	07	103.4	27.7	67	161.3	43.2	27	219.3	58.8	87	277.2	74.3
48	46.4	12.4	08	104.3	28.0	68	162.3	43.5	28	220.2	59.0	88	278.2	74.5
49	47.3	12.7	09	105.3	28.2	69	163.2	43.7	29	221.2	59.3	89	279.2	74.8
50	48.3	12.9	10	106.3	28.5	70	164.2	44.0	30	222.2	59.5	90	280.1	75.1
51	49.3	13.2	111	107.2	28.7	171	165.2	44.3	231	223.1	59.8	291	281.1	75.3
52	50.2	13.5	12	108.2	29.0	72	166.1	44.5	32	224.1	60.0	92	282.1	75.6
53	51.2	13.7	13	109.1	29.2	73	167.1	44.8	33	225.1	60.3	93	283.0	75.8
54	52.2	14.0	14	110.1	29.5	74	168.1	45.0	34	226.0	60.6	94	284.0	76.1
55	53.1	14.2	15	111.1	29.8	75	169.0	45.3	35	227.0	60.8	95	284.9	76.4
56	54.1	14.5	16	112.0	30.0	76	170.0	45.6	36	228.0	61.1	96	285.9	76.6
57	55.1	14.8	17	113.0	30.3	77	171.0	45.8	37	228.9	61.3	97	286.9	76.9
58	56.0	15.0	18	114.0	30.5	78	171.9	46.1	38	229.9	61.6	98	287.8	77.1
59	57.0	15.3	19	114.9	30.8	79	172.9	46.3	39	230.9	61.9	99	288.8	77.4
60	58.0	15.5	20	115.9	31.1	80	173.9	46.6	40	231.8	62.1	300	289.8	77.6
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 75 Degrees

Table II. Difference of Latitude and Departure for 18 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.3	61	58.0	18.9	121	115.1	37.4	181	172.1	55.9	241	229.2	74.5
2	01.9	00.6	62	59.0	19.2	22	116.0	37.7	82	173.1	56.2	42	230.2	74.8
3	02.9	00.9	63	59.9	19.5	23	117.0	38.0	83	174.0	56.6	43	231.1	75.1
4	03.8	01.2	64	60.9	19.8	24	117.9	38.3	84	175.0	56.9	44	232.1	75.4
5	04.8	01.5	65	61.8	20.1	25	118.9	38.6	85	175.9	57.2	45	233.0	75.7
6	05.7	01.9	66	62.8	20.4	26	119.8	38.9	86	176.9	57.5	46	234.0	76.0
7	06.7	02.2	67	63.7	20.7	27	120.8	39.2	87	177.8	57.8	47	234.9	76.3
8	07.6	02.5	68	64.7	21.0	28	121.7	39.6	88	178.8	58.1	48	235.9	76.6
9	08.6	02.8	69	65.6	21.3	29	122.7	39.9	89	179.7	58.4	49	236.8	76.9
10	09.5	03.1	70	66.6	21.6	30	123.6	40.2	90	180.7	58.7	50	237.8	77.3
11	10.5	03.4	71	67.5	21.9	131	124.6	40.5	191	181.7	59.0	251	238.7	77.6
12	11.4	03.7	72	68.5	22.2	32	125.5	40.8	92	182.6	59.3	52	239.7	77.9
13	12.4	04.0	73	69.4	22.6	33	126.5	41.1	93	183.6	59.6	53	240.6	78.2
14	13.3	04.3	74	70.4	22.9	34	127.4	41.4	94	184.5	59.9	54	241.6	78.5
15	14.3	04.6	75	71.3	23.2	35	128.4	41.7	95	185.5	60.3	55	242.5	78.8
16	15.2	04.9	76	72.3	23.5	36	129.3	42.0	96	186.4	60.6	56	243.5	79.1
17	16.2	05.3	77	73.2	23.8	37	130.3	42.3	97	187.4	60.9	57	244.4	79.4
18	17.1	05.6	78	74.2	24.1	38	131.2	42.6	98	188.3	61.2	58	245.4	79.7
19	18.1	05.9	79	75.1	24.4	39	132.2	43.0	99	189.3	61.5	59	246.3	80.0
20	19.0	06.2	80	76.1	24.7	40	133.1	43.3	200	190.2	61.8	60	247.3	80.3
21	20.0	06.5	81	77.0	25.0	141	134.1	43.6	201	191.2	62.1	261	248.2	80.7
22	20.9	06.8	82	78.0	25.3	42	135.1	43.9	02	192.1	62.4	62	249.2	81.0
23	21.9	07.1	83	78.9	25.6	43	136.0	44.2	03	193.1	62.7	63	250.1	81.3
24	22.8	07.4	84	79.9	26.0	44	137.0	44.5	04	194.0	63.0	64	251.1	81.6
25	23.8	07.7	85	80.8	26.3	45	137.9	44.8	05	195.0	63.3	65	252.0	81.9
26	24.7	08.0	86	81.8	26.6	46	138.9	45.1	06	195.9	63.7	66	253.0	82.2
27	25.7	08.3	87	82.7	26.9	47	139.8	45.4	07	196.9	64.0	67	253.9	82.5
28	26.6	08.7	88	83.7	27.2	48	140.8	45.7	08	197.8	64.3	68	254.9	82.8
29	27.6	09.0	89	84.6	27.5	49	141.7	46.0	09	198.8	64.6	69	255.8	83.1
30	28.5	09.3	90	85.6	27.8	50	142.7	46.4	10	199.7	64.9	70	256.8	83.4
31	29.5	09.6	91	86.5	28.1	151	143.6	46.7	211	200.7	65.2	271	257.7	83.7
32	30.4	09.9	92	87.5	28.4	52	144.6	47.0	12	201.6	65.5	72	258.7	84.1
33	31.4	10.2	93	88.4	28.7	53	145.5	47.3	13	202.6	65.8	73	259.6	84.4
34	32.3	10.5	94	89.4	29.0	54	146.5	47.6	14	203.5	66.1	74	260.6	84.7
35	33.3	10.8	95	90.4	29.4	55	147.4	47.9	15	204.5	66.4	75	261.5	85.0
36	34.2	11.1	96	91.3	39.7	56	148.4	48.2	16	205.4	66.7	76	262.5	85.3
37	35.2	11.4	97	92.3	30.0	57	149.3	48.5	17	206.4	67.1	77	263.4	85.6
38	36.1	11.7	98	93.2	30.3	58	150.3	48.8	18	207.3	67.4	78	264.4	85.9
39	37.1	12.1	99	94.2	30.6	59	151.2	49.1	19	208.3	67.7	79	265.3	86.2
40	38.0	12.4	100	95.1	30.9	60	152.2	49.4	20	209.2	68.0	80	266.3	86.5
41	39.0	12.7	101	96.1	31.2	161	153.1	49.8	221	210.2	68.3	281	267.2	86.8
42	39.9	13.0	02	97.0	31.5	62	154.1	50.1	22	211.1	68.6	82	268.2	87.1
43	40.9	13.3	03	98.0	31.8	63	155.0	50.4	23	212.1	68.9	83	269.1	87.4
44	41.8	13.6	04	98.9	32.1	64	156.0	50.7	24	213.0	69.2	84	270.1	87.8
45	42.8	13.9	05	99.9	32.4	65	156.9	51.0	25	214.0	69.5	85	271.1	88.1
46	43.7	14.2	06	100.8	32.8	66	157.9	51.3	26	214.9	69.8	86	272.0	88.4
47	44.7	14.5	07	101.8	33.1	67	158.8	51.6	27	215.9	70.1	87	273.0	88.7
48	45.7	14.8	08	102.7	33.4	68	159.8	51.9	28	216.8	70.5	88	273.9	89.0
49	46.6	15.1	09	103.7	33.7	69	160.7	52.2	29	217.8	70.8	89	274.9	89.3
50	47.6	15.5	10	104.6	34.0	70	161.7	52.5	30	218.7	71.1	90	275.8	89.6
51	48.5	15.8	111	105.6	34.3	171	162.6	52.8	231	219.7	71.4	291	276.8	89.9
52	49.5	16.1	12	106.5	34.6	72	163.6	53.2	32	220.6	71.7	92	277.7	90.2
53	50.4	16.4	13	107.5	34.9	73	164.5	53.5	33	221.6	72.0	93	278.7	90.5
54	51.4	16.7	14	108.4	35.2	74	165.5	53.8	34	222.5	72.3	94	279.6	90.9
55	52.3	17.0	15	109.4	35.5	75	166.4	54.1	35	223.5	72.6	95	280.6	91.2
56	53.3	17.3	16	110.3	35.8	76	167.4	54.4	36	224.4	72.9	96	281.5	91.5
57	54.2	17.6	17	111.3	36.2	77	168.3	54.7	37	225.4	73.2	97	282.5	91.8
58	55.2	17.9	18	112.2	36.5	78	169.3	55.0	38	226.4	73.5	98	283.4	92.1
59	56.1	18.2	19	113.2	36.8	79	170.2	55.3	39	227.3	73.9	99	284.4	92.4
60	57.1	18.5	20	114.1	37.1	80	171.2	55.6	40	228.3	74.2	300	285.3	92.7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 72 Degrees.

TABLE II. Difference of Latitude and Departure for 17 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.3	61	58.3	17.8	121	115.7	35.4	161	173.1	52.9	241	230.5	70.5
2	01.9	00.6	62	59.3	18.1	22	116.7	35.7	82	174.0	53.2	42	231.4	70.7
3	02.9	00.9	63	60.2	18.4	23	117.6	36.0	83	175.0	53.5	43	232.4	71.0
4	03.8	01.2	64	61.2	18.7	24	118.6	36.3	84	176.0	53.8	44	233.3	71.3
5	04.8	01.5	65	62.2	19.0	25	119.5	36.5	85	176.9	54.1	45	234.3	71.6
6	05.7	01.8	66	63.1	19.3	26	120.5	36.8	86	177.9	54.4	46	235.3	71.9
7	06.7	02.0	67	64.1	19.6	27	121.5	37.1	87	178.9	54.7	47	236.2	72.2
8	07.7	02.3	68	65.0	19.9	28	122.4	37.4	88	179.8	55.0	48	237.2	72.4
9	08.6	02.6	69	66.0	20.2	29	123.4	37.7	89	180.7	55.3	49	238.1	72.7
10	09.6	02.9	70	66.9	20.5	30	124.3	38.0	90	181.7	55.6	50	239.1	73.1
11	10.5	03.2	71	67.9	20.8	131	125.3	38.3	191	182.7	55.8	251	240.0	73.3
12	11.5	03.5	72	68.9	20.9	32	126.2	38.6	92	183.6	56.1	52	241.0	73.6
13	12.4	03.8	73	69.8	21.3	33	127.2	38.9	93	184.6	56.4	53	141.9	74.0
14	13.4	04.1	74	70.8	21.6	34	128.1	39.2	94	185.5	56.7	54	242.9	74.1
15	14.3	04.4	75	71.7	21.9	35	129.1	39.5	95	186.5	57.0	55	243.9	74.4
16	15.3	04.7	76	72.7	22.2	36	130.1	39.8	96	187.4	57.3	56	244.8	74.7
17	16.3	05.0	77	73.6	22.5	37	131.0	40.1	97	188.4	57.6	57	245.8	75.1
18	17.2	05.3	78	74.6	22.8	38	132.0	40.3	98	189.3	57.9	58	246.7	75.3
19	18.2	05.6	79	75.5	23.1	39	132.9	40.6	99	190.3	58.2	59	247.7	75.6
20	19.1	05.8	80	76.5	23.4	40	133.9	40.9	200	191.3	58.5	60	248.6	75.9
21	20.1	06.1	81	77.5	23.7	141	134.8	41.2	201	192.2	58.8	261	249.6	76.2
22	21.0	06.4	82	78.4	24.0	42	135.8	41.5	02	193.2	59.1	62	250.6	76.6
23	22.0	06.7	83	79.4	24.3	43	136.8	41.8	03	194.1	59.4	63	251.5	76.8
24	22.9	07.0	84	80.3	24.6	44	137.7	42.1	04	195.1	59.6	64	252.5	77.1
25	23.9	07.3	85	81.3	24.9	45	138.7	42.4	05	196.0	59.9	65	253.4	77.4
26	24.9	07.6	86	82.2	25.1	46	139.6	42.7	06	197.0	60.2	66	254.4	77.7
27	25.8	07.9	87	83.2	25.4	47	140.6	43.0	07	198.0	60.5	67	255.3	78.1
28	26.8	08.2	88	84.2	25.7	48	141.5	43.3	08	198.9	60.8	68	256.3	78.4
29	27.7	08.5	89	85.1	26.0	49	142.5	43.6	09	199.9	61.1	69	257.2	78.6
30	28.7	08.8	90	86.1	26.3	50	143.4	43.9	10	200.8	61.4	70	258.2	78.9
31	29.6	09.1	91	87.0	26.6	151	144.4	44.1	211	201.8	61.7	271	259.2	79.2
32	30.6	09.4	92	88.0	26.9	52	145.4	44.4	12	202.7	62.0	72	260.1	79.5
33	31.6	09.6	93	88.9	27.2	53	146.3	44.7	13	203.7	62.3	73	261.1	79.7
34	32.5	09.9	94	89.9	27.5	54	147.3	45.0	14	204.6	62.6	74	262.0	80.0
35	33.5	10.2	95	90.8	27.8	55	148.2	45.3	15	205.6	62.9	75	263.0	80.3
36	34.4	10.5	96	91.8	28.1	56	149.2	45.6	16	206.6	63.2	76	263.9	80.6
37	35.4	10.8	97	92.8	28.4	57	150.1	45.9	17	207.5	63.4	77	264.9	81.0
38	36.3	11.1	98	93.7	28.7	58	151.1	46.2	18	208.5	63.7	78	265.9	81.2
39	37.3	11.4	99	94.7	28.9	59	152.1	46.5	19	209.4	64.0	79	266.8	81.5
40	38.3	11.7	100	95.6	29.2	60	153.0	46.8	20	210.4	64.3	80	267.8	81.7
41	39.2	12.0	101	96.6	29.5	161	154.0	47.1	221	211.3	64.6	281	268.7	82.0
42	40.2	12.3	02	97.5	29.8	62	154.9	47.4	22	212.3	64.9	82	269.7	82.3
43	41.1	12.6	03	98.5	30.1	63	155.9	47.7	23	213.3	65.2	83	270.6	82.6
44	42.1	12.9	04	99.5	30.4	64	156.8	47.9	24	214.2	65.5	84	271.6	82.9
45	43.0	13.2	05	100.4	30.7	65	157.8	48.2	25	215.2	65.8	85	272.5	83.2
46	44.0	13.4	06	101.4	31.0	66	158.7	48.5	26	216.1	66.1	86	273.5	83.5
47	44.9	13.7	07	102.3	31.3	67	159.7	48.8	27	217.1	66.4	87	274.5	83.9
48	45.9	14.0	08	103.3	31.6	68	160.7	49.1	28	218.0	66.7	88	275.4	84.1
49	46.9	14.3	09	104.2	31.9	69	161.6	49.4	29	219.0	67.0	89	276.4	84.4
50	47.8	14.6	10	105.2	32.2	70	162.6	49.7	30	220.0	67.2	90	277.3	84.7
51	48.8	14.9	111	106.1	32.5	171	163.5	50.0	231	220.9	69.5	291	278.3	85.0
52	49.7	15.2	12	107.1	32.7	72	164.5	50.3	32	221.8	67.8	92	279.2	85.4
53	50.7	15.5	13	108.1	33.0	73	165.4	50.6	33	222.8	68.1	93	280.2	85.7
54	51.6	15.8	14	109.0	33.3	74	166.4	50.9	34	223.8	68.4	94	281.2	86.0
55	52.6	16.1	15	110.0	33.6	75	167.4	51.2	35	224.7	68.7	95	282.1	86.1
56	53.6	16.4	16	110.9	33.9	76	168.3	51.5	36	225.7	69.0	96	283.1	86.4
57	54.5	16.7	17	111.9	34.2	77	169.3	51.7	37	226.6	69.3	97	284.0	86.8
58	55.5	17.0	18	112.8	34.5	78	170.2	52.0	38	227.6	69.6	98	285.0	87.0
59	56.4	17.2	19	113.8	34.8	79	171.2	52.3	39	228.6	69.9	99	285.9	87.3
60	57.4	37.5	20	114.8	35.1	80	172.1	52.6	40	229.5	70.2	300	186.9	87.7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 73 Degrees.

TABLE II. Difference of Latitude and Departure for 20 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.3	61	57.3	20.9	121	113.7	41.4	181	170.1	61.9	241	226.5	82.4
2	01.9	00.7	62	58.3	21.2	22	114.6	41.7	82	171.0	62.2	42	227.4	82.8
3	02.8	01.0	63	59.2	21.5	23	115.6	42.1	83	172.0	62.6	43	228.3	83.1
4	03.8	01.4	64	60.1	21.9	24	116.5	42.4	84	172.9	62.9	44	229.3	83.5
5	04.7	01.7	65	61.1	22.2	25	117.5	42.8	85	173.8	63.3	45	230.2	83.8
6	05.6	02.1	66	62.0	22.6	26	118.4	43.1	86	174.8	63.6	46	231.2	84.1
7	06.6	02.4	67	63.0	22.9	27	119.3	43.4	87	175.7	64.0	47	232.1	84.5
8	07.5	02.7	68	63.9	23.3	28	120.3	43.8	88	176.7	64.3	48	233.0	84.8
9	08.5	03.1	69	64.8	23.6	29	121.2	44.1	89	177.6	64.6	49	234.0	85.2
10	09.4	03.4	70	65.8	23.9	30	122.2	44.5	90	178.5	65.0	50	234.9	85.5
11	10.3	03.8	71	66.7	24.3	131	123.1	44.8	191	179.5	65.3	251	235.9	85.8
12	11.3	04.1	72	67.7	24.6	32	124.0	45.1	92	180.4	65.7	52	236.8	86.2
13	12.2	04.4	73	68.6	25.0	33	125.0	45.5	93	181.4	66.0	53	237.7	86.5
14	13.2	04.8	74	69.5	25.3	34	125.9	45.8	94	182.3	66.4	54	238.7	86.9
15	14.1	05.1	75	70.5	25.7	35	126.9	46.2	95	183.2	66.7	55	239.6	87.2
16	15.0	05.5	76	71.4	26.0	36	127.8	46.5	96	184.2	67.0	56	240.6	87.6
17	16.0	05.8	77	72.4	26.3	37	128.7	46.9	97	185.1	67.4	57	241.5	87.9
18	16.9	06.2	78	73.3	26.7	38	129.7	47.2	98	186.1	67.7	58	242.4	88.2
19	17.9	06.5	79	74.2	27.0	39	130.6	47.5	99	187.0	68.1	59	243.4	98.6
20	18.8	06.8	80	75.2	27.4	40	131.6	47.9	200	187.9	68.4	60	244.3	88.9
21	19.7	07.2	81	76.1	27.7	141	132.5	48.2	201	188.9	68.7	261	245.3	89.3
22	20.7	07.5	82	77.1	28.0	42	133.4	48.6	02	189.8	69.1	62	246.2	89.6
23	21.6	07.9	83	78.0	28.4	43	134.4	48.9	03	190.8	69.4	63	247.1	90.0
24	22.6	08.2	84	78.9	28.7	44	135.3	49.3	04	191.7	69.8	64	248.1	90.3
25	23.5	08.6	85	79.9	29.1	45	136.3	49.6	05	192.6	70.1	65	249.0	90.6
26	24.4	08.9	86	80.8	29.4	46	137.2	49.9	06	193.6	70.5	66	250.0	91.0
27	25.4	09.2	87	81.8	29.8	47	138.1	50.3	07	194.5	70.8	67	250.9	91.3
28	26.3	09.6	88	82.7	30.1	48	139.1	50.6	08	195.5	71.1	68	251.8	91.7
29	27.3	09.9	89	83.6	30.4	49	140.0	51.0	09	196.4	71.5	69	252.8	92.0
30	28.2	10.3	90	84.6	30.8	50	141.0	51.3	10	197.3	71.8	70	253.7	92.3
31	29.1	10.6	91	85.5	31.1	151	141.9	51.6	211	198.3	72.2	271	254.7	92.7
32	30.1	10.9	92	86.5	31.5	52	142.8	52.0	12	199.2	72.5	72	255.6	93.0
33	31.0	11.3	93	87.4	31.8	53	143.8	52.3	13	200.2	72.9	73	256.5	93.4
34	31.9	11.6	94	88.3	32.1	54	144.7	52.7	14	201.1	73.2	74	257.5	93.7
35	32.9	12.0	95	89.3	32.5	55	145.7	53.0	15	202.0	73.5	75	258.4	94.1
36	33.8	12.3	96	90.2	32.8	56	146.6	53.4	16	203.0	73.9	76	259.4	94.4
37	34.8	12.7	97	91.2	33.2	57	147.5	53.7	17	203.9	74.2	77	260.3	94.7
38	35.7	13.0	98	92.1	33.5	58	148.5	54.0	18	204.9	74.6	78	261.2	95.1
39	36.6	13.3	99	93.0	33.9	59	149.4	54.4	19	205.8	74.9	79	262.2	95.4
40	37.6	13.7	100	94.0	34.2	60	150.4	54.7	20	206.7	75.2	80	263.1	95.8
41	38.5	14.0	101	94.9	34.5	161	151.3	55.1	221	207.7	75.6	281	264.1	96.1
42	39.5	14.4	02	95.8	34.9	62	152.2	55.4	22	208.6	75.9	82	265.0	96.4
43	40.4	14.7	03	96.8	35.2	63	153.2	55.7	23	209.6	76.3	83	265.9	96.8
44	41.3	15.0	04	97.7	35.6	64	154.1	56.1	24	210.5	76.6	84	266.9	97.1
45	42.3	15.4	05	98.7	35.9	65	155.0	56.4	25	211.4	77.0	85	267.8	97.5
46	43.2	15.7	06	99.6	36.3	66	156.0	56.8	26	212.4	77.3	86	268.8	97.8
47	44.2	16.1	07	100.5	36.6	67	156.9	57.1	27	213.3	77.6	87	269.7	98.2
48	45.1	16.4	08	101.5	36.9	68	157.9	57.5	28	214.2	78.0	88	270.6	98.5
49	46.0	16.8	09	102.4	37.3	69	158.8	57.8	29	215.2	78.3	89	271.6	98.8
50	47.0	17.1	10	103.4	37.6	70	159.7	58.1	30	216.1	78.7	90	272.5	99.2
51	47.9	17.4	111	104.3	38.0	171	160.7	58.5	231	217.1	79.0	291	273.5	99.5
52	48.9	17.8	12	105.2	38.3	72	161.6	58.8	32	218.0	79.3	92	274.4	99.9
53	49.8	18.1	13	106.2	38.6	73	162.6	59.2	33	219.0	79.7	93	275.3	100.2
54	50.7	18.5	14	107.1	39.0	74	163.5	59.5	34	219.9	80.0	94	276.3	100.5
55	51.7	18.8	15	108.1	39.3	75	164.4	59.9	35	220.8	80.4	95	277.2	100.9
56	52.6	19.2	16	109.0	39.7	76	165.4	60.2	36	221.8	80.7	96	278.1	101.2
57	53.6	19.5	17	109.9	40.0	77	166.3	60.5	37	222.7	81.1	97	279.1	101.6
58	54.5	19.8	18	110.9	40.4	78	167.3	60.9	38	223.6	81.4	98	280.0	101.9
59	55.4	20.2	19	111.8	40.7	79	168.2	61.2	39	224.6	81.7	99	281.0	102.3
60	56.4	20.5	20	112.8	41.0	80	169.1	61.6	40	225.5	82.1	300	281.9	102.6
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 70 Degrees.

TABLE II. Difference of Latitude and Departure for 21 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.4	61	56.9	21.9	121	113.0	43.4	181	169.0	64.9	241	225.0	86.4
2	01.9	00.7	62	57.9	22.2	22	113.9	43.7	82	169.9	65.2	42	225.9	86.7
3	02.8	01.1	63	58.8	22.6	23	114.8	44.1	83	170.8	65.6	43	226.9	87.1
4	03.7	01.4	64	59.7	22.9	24	115.8	44.4	84	171.8	65.9	44	227.8	87.4
5	04.7	01.8	65	60.7	23.3	25	116.7	44.8	85	172.7	66.3	45	228.7	87.8
6	05.6	02.2	66	61.6	23.7	26	117.6	45.2	86	173.6	66.7	46	229.7	88.2
7	06.5	02.5	67	62.5	24.0	27	118.6	45.5	87	174.6	67.0	47	230.6	88.5
8	07.5	02.9	68	63.5	24.4	28	119.5	45.9	88	175.5	67.4	48	231.5	88.9
9	08.4	03.2	69	64.4	24.7	29	120.4	46.2	89	176.4	67.7	49	232.5	89.2
10	09.3	03.6	70	65.4	25.1	30	121.4	46.6	90	177.4	68.1	50	233.4	89.6
11	10.3	03.9	71	66.3	25.4	131	122.3	46.9	191	178.3	68.4	251	234.3	90.0
12	11.2	04.3	72	67.2	25.8	32	123.2	47.3	92	179.2	68.8	52	235.3	90.3
13	12.1	04.7	73	68.2	26.2	33	124.2	47.7	93	180.2	69.2	53	236.2	90.7
14	13.1	05.0	74	69.1	26.5	34	125.1	48.0	94	181.1	69.5	54	237.1	91.0
15	14.0	05.4	75	70.0	26.9	35	126.0	48.4	95	182.0	69.9	55	238.1	91.4
16	14.9	05.7	76	70.9	27.2	36	127.0	48.7	96	183.0	70.2	56	239.0	91.7
17	15.9	06.1	77	71.9	27.6	37	127.9	49.1	97	183.9	70.6	57	239.9	92.1
18	16.8	06.5	78	72.8	28.0	38	128.8	49.5	98	184.8	71.0	58	240.9	92.5
19	17.7	06.8	79	73.8	28.3	39	129.8	49.8	99	185.8	71.3	59	241.8	92.8
20	18.7	07.2	80	74.7	28.7	40	130.7	50.2	200	186.7	71.7	60	242.7	93.2
21	19.6	07.5	81	75.6	29.0	141	131.6	50.5	201	187.6	72.0	261	243.7	93.5
22	20.5	07.9	82	76.6	29.4	42	132.6	50.9	02	188.6	72.4	62	244.6	93.9
23	21.5	08.2	83	77.5	29.7	43	133.5	51.2	03	189.5	72.7	63	245.5	94.3
24	22.4	08.6	84	78.4	30.1	44	134.4	51.6	04	190.5	73.1	64	246.5	94.6
25	23.3	09.0	85	79.4	30.5	45	135.4	52.0	05	191.4	73.5	65	247.4	95.0
26	24.3	09.3	86	80.3	30.8	46	136.3	52.3	06	192.3	73.8	66	248.3	95.3
27	25.2	09.7	87	81.2	31.2	47	137.2	52.7	07	193.3	74.2	67	249.3	95.7
28	26.1	10.0	88	82.2	31.5	48	138.2	53.0	08	194.2	74.5	68	250.2	96.0
29	27.1	10.4	89	83.1	31.9	49	139.1	53.4	09	195.1	74.9	69	251.1	96.4
30	28.0	10.8	90	84.0	32.3	50	140.0	53.8	10	196.1	75.3	70	252.1	96.8
31	28.9	11.1	91	85.0	32.6	151	141.0	54.1	211	197.0	75.6	271	253.0	97.1
32	29.9	11.5	92	85.9	33.0	52	141.9	54.5	12	197.9	76.0	72	253.9	97.5
33	30.8	11.8	93	86.8	33.3	53	142.8	54.8	13	198.9	76.3	73	254.9	97.8
34	31.7	12.2	94	87.8	33.7	54	143.8	55.2	14	199.8	76.7	74	255.8	98.2
35	32.7	12.5	95	88.7	34.0	55	144.7	55.5	15	200.7	77.0	75	256.7	98.6
36	33.6	12.9	96	89.6	34.4	56	145.6	55.9	16	201.7	77.4	76	257.7	98.9
37	34.5	13.3	97	90.6	34.8	57	146.6	56.3	17	202.6	77.8	77	258.6	99.3
38	35.5	13.6	98	91.5	35.1	58	147.5	56.6	18	203.5	78.1	78	259.5	99.6
39	36.4	14.0	99	92.4	35.5	59	148.4	57.0	19	204.5	78.5	79	260.5	100.0
40	37.3	14.3	100	93.4	35.8	60	149.4	57.3	20	205.4	78.8	80	261.4	100.3
41	38.3	14.7	101	94.3	36.2	161	150.3	57.7	221	206.3	79.2	281	262.3	100.7
42	39.2	15.1	02	95.2	36.6	62	151.2	58.1	22	207.3	79.6	82	263.3	101.1
43	40.1	15.4	03	96.2	36.9	63	152.2	58.4	23	208.2	79.9	83	264.2	101.4
44	41.1	15.8	04	97.1	37.3	64	153.1	58.8	24	209.1	80.3	84	265.1	101.8
45	42.0	16.1	05	98.0	37.6	65	154.0	59.1	25	210.1	80.6	85	266.1	102.1
46	42.9	16.5	06	99.0	38.0	66	155.0	59.5	26	211.0	81.0	86	267.0	102.5
47	43.9	16.8	07	99.9	38.3	67	155.9	59.8	27	211.9	81.3	87	267.9	102.9
48	44.8	17.2	08	100.8	38.7	68	156.8	60.2	28	212.9	81.7	88	268.9	103.2
49	45.7	17.6	09	101.8	39.1	69	157.8	60.6	29	213.8	82.1	89	269.8	103.6
50	46.7	17.9	10	102.7	39.4	70	158.7	60.9	30	214.7	82.4	90	260.7	103.9
51	47.6	18.3	111	103.6	39.8	171	159.6	61.3	231	215.7	82.8	291	271.7	104.3
52	48.5	18.6	12	104.6	40.1	72	160.6	61.6	32	216.6	83.1	92	272.6	104.6
53	49.5	19.0	13	105.5	40.5	73	161.5	62.0	33	217.5	83.5	93	273.5	105.0
54	50.4	19.4	14	106.4	40.9	74	162.4	62.4	34	218.5	83.9	94	274.5	105.4
55	51.3	19.7	15	107.4	41.2	75	163.4	62.7	35	219.4	84.2	95	275.4	105.7
56	52.3	20.1	16	108.3	41.6	76	164.3	63.1	36	220.3	84.6	96	276.3	106.1
57	53.2	20.4	17	109.2	41.9	77	165.2	63.4	37	221.3	84.9	97	277.3	106.4
58	54.1	20.8	18	110.2	42.3	78	166.2	63.8	38	222.2	85.3	98	278.2	106.8
59	55.1	21.1	19	111.1	42.6	79	167.1	64.1	39	223.1	85.6	99	279.1	107.2
60	56.0	21.5	20	112.0	43.0	80	168.0	64.5	40	224.1	86.0	300	280.1	107.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 69 Degrees

TABLE II. Difference of Latitude and Departure for 20 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.3	61	57.3	20.9	121	113.7	41.4	181	170.1	61.9	241	226.5	82.4
2	01.9	00.7	62	58.3	21.2	22	114.6	41.7	82	171.0	62.2	42	227.4	82.8
3	02.8	01.0	63	59.2	21.5	23	115.6	42.1	83	172.0	62.6	43	228.3	83.1
4	03.8	01.4	64	60.1	21.9	24	116.5	42.4	84	172.9	62.9	44	229.3	83.5
5	04.7	01.7	65	61.1	22.2	25	117.5	42.8	85	173.8	63.3	45	230.2	83.8
6	05.6	02.1	66	62.0	22.6	26	118.4	43.1	86	174.8	63.6	46	231.2	84.1
7	06.6	02.4	67	63.0	22.9	27	119.3	43.4	87	175.7	64.0	47	232.1	84.5
8	07.5	02.7	68	63.9	23.3	28	120.3	43.8	88	176.7	64.3	48	233.0	84.8
9	08.5	03.1	69	64.8	23.6	29	121.2	44.1	89	177.6	64.6	49	234.0	85.2
10	09.4	03.4	70	65.8	23.9	30	122.2	44.5	90	178.5	65.0	50	234.9	85.5
11	10.3	03.8	71	66.7	24.3	131	123.1	44.8	191	179.5	65.3	251	235.9	85.8
12	11.3	04.1	72	67.7	24.6	32	124.0	45.1	92	180.4	65.7	52	236.8	86.2
13	12.2	04.4	73	68.6	25.0	33	125.0	45.5	93	181.4	66.0	53	237.7	86.5
14	13.2	04.8	74	69.5	25.3	34	125.9	45.8	94	182.3	66.4	54	238.7	86.9
15	14.1	05.1	75	70.5	25.7	35	126.9	46.2	95	183.2	66.7	55	239.6	87.2
16	15.0	05.5	76	71.4	26.0	36	127.8	46.5	96	184.2	67.0	56	240.6	87.6
17	16.0	05.8	77	72.4	26.3	37	128.7	46.9	97	185.1	67.4	57	241.5	87.9
18	16.9	06.2	78	73.3	26.7	38	129.7	47.2	98	186.1	67.7	58	242.4	88.2
19	17.9	06.5	79	74.2	27.0	39	130.6	47.5	99	187.0	68.1	59	243.4	88.6
20	18.8	06.8	80	75.2	27.4	40	131.6	47.9	200	187.9	68.4	60	244.3	88.9
21	19.7	07.2	81	76.1	27.7	141	132.5	48.2	201	188.9	68.7	261	245.3	89.3
22	20.7	07.5	82	77.1	28.0	42	133.4	48.6	02	189.8	69.1	62	246.2	89.6
23	21.6	07.9	83	78.0	28.4	43	134.4	48.9	03	190.8	69.4	63	247.1	90.0
24	22.6	08.2	84	78.9	28.7	44	135.3	49.3	04	191.7	69.8	64	248.1	90.3
25	23.5	08.6	85	79.9	29.1	45	136.3	49.6	05	192.6	70.1	65	249.0	90.6
26	24.4	08.9	86	80.8	29.4	46	137.2	49.9	06	193.6	70.5	66	250.0	91.0
27	25.4	09.2	87	81.8	29.8	47	138.1	50.3	07	194.5	70.8	67	250.9	91.3
28	26.3	09.6	88	82.7	30.1	48	139.1	50.6	08	195.5	71.1	68	251.8	91.7
29	27.3	09.9	89	83.6	30.4	49	140.0	51.0	09	196.4	71.5	69	252.8	92.0
30	28.2	10.3	90	84.6	30.8	50	141.0	51.3	10	197.3	71.8	70	253.7	92.3
31	29.1	10.6	91	85.5	31.1	151	141.9	51.6	211	198.3	72.2	271	254.7	92.7
32	30.1	10.9	92	86.5	31.5	52	142.8	52.0	12	199.2	72.5	72	255.6	93.0
33	31.0	11.3	93	87.4	31.8	53	143.8	52.3	13	200.2	72.9	73	256.5	93.4
34	31.9	11.6	94	88.3	32.1	54	144.7	52.7	14	201.1	73.2	74	257.5	93.7
35	32.9	12.0	95	89.3	32.5	55	145.7	53.0	15	202.0	73.5	75	258.4	94.1
36	33.8	12.3	96	90.2	32.8	56	146.6	53.4	16	203.0	73.9	76	259.4	94.4
37	34.8	12.7	97	91.2	33.2	57	147.5	53.7	17	203.9	74.2	77	260.3	94.7
38	35.7	13.0	98	92.1	33.5	58	148.5	54.0	18	204.9	74.6	78	261.2	95.1
39	36.6	13.3	99	93.0	33.9	59	149.4	54.4	19	205.8	74.9	79	262.2	95.4
40	37.6	13.7	100	94.0	34.2	60	150.4	54.7	20	206.7	75.2	80	263.1	95.8
41	38.5	14.0	101	94.9	34.5	161	151.3	55.1	221	207.7	75.6	281	264.1	96.1
42	39.5	14.4	02	95.8	34.9	62	152.2	55.4	22	208.6	75.9	82	265.0	96.4
43	40.4	14.7	03	96.8	35.2	63	153.2	55.7	23	209.6	76.3	83	265.9	96.8
44	41.3	15.0	04	97.7	35.6	64	154.1	56.1	24	210.5	76.6	84	266.9	97.1
45	42.3	15.4	05	98.7	35.9	65	155.0	56.4	25	211.4	77.0	85	267.8	97.5
46	43.2	15.7	06	99.6	36.3	66	156.0	56.8	26	212.4	77.3	86	268.8	97.8
47	44.2	16.1	07	100.5	36.6	67	156.9	57.1	27	213.3	77.6	87	269.7	98.2
48	45.1	16.4	08	101.5	36.9	68	157.9	57.5	28	214.2	78.0	88	270.6	98.5
49	46.0	16.8	09	102.4	37.3	69	158.8	57.8	29	215.2	78.3	89	271.6	98.8
50	47.0	17.1	10	103.4	37.6	70	159.7	58.1	30	216.1	78.7	90	272.5	99.2
51	47.9	17.4	111	104.3	38.0	171	160.7	58.5	231	217.1	79.0	291	273.5	99.5
52	48.9	17.8	12	105.2	38.3	72	161.6	58.8	32	218.0	79.3	92	274.4	99.9
53	49.8	18.1	13	106.2	38.6	73	162.6	59.2	33	219.0	79.7	93	275.3	100.1
54	50.7	18.5	14	107.1	39.0	74	163.5	59.5	34	219.9	80.0	94	276.3	100.5
55	51.7	18.8	15	108.1	39.3	75	164.4	59.9	35	220.8	80.4	95	277.2	100.9
56	52.6	19.2	16	109.0	39.7	76	165.4	60.2	36	221.8	80.7	96	278.1	101.2
57	53.6	19.5	17	109.9	40.0	77	166.3	60.5	37	222.7	81.1	97	279.1	101.6
58	54.5	19.8	18	110.9	40.4	78	167.3	60.9	38	223.6	81.4	98	280.0	101.9
59	55.4	20.2	19	111.8	40.7	79	168.2	61.2	39	224.6	81.7	99	281.0	102.3
60	56.4	20.5	20	112.8	41.0	80	169.1	61.6	40	225.5	82.1	300	281.9	102.6
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 70 Degrees.

TABLE II. Difference of Latitude and Departure for 21 Degrees.

Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	00.9	00.4	61	56.9	21.9	121	113.0	43.4	181	169.0	64.9	241	225.0	86.4
2	01.9	00.7	62	57.9	22.2	22	113.9	43.7	82	169.9	65.2	42	225.9	86.7
3	02.8	01.1	63	58.8	22.6	23	114.8	44.1	83	170.8	65.6	43	226.9	87.1
4	03.7	01.4	64	59.7	22.9	24	115.8	44.4	84	171.8	65.9	44	227.8	87.4
5	04.7	01.8	65	60.7	23.3	25	116.7	44.8	85	172.7	66.3	45	228.7	87.8
6	05.6	02.2	66	61.6	23.7	26	117.6	45.2	86	173.6	66.7	46	229.7	88.2
7	06.5	02.5	67	62.5	24.0	27	118.6	45.5	87	174.6	67.0	47	230.6	88.5
8	07.5	02.9	68	63.5	24.4	28	119.5	45.9	88	175.5	67.4	48	231.5	88.9
9	08.4	03.2	69	64.4	24.7	29	120.4	46.2	89	176.4	67.7	49	232.5	89.2
10	09.3	03.6	70	65.4	25.1	30	121.4	46.6	90	177.4	68.1	50	233.4	89.6
11	10.3	03.9	71	66.3	25.4	131	122.3	46.9	191	178.3	68.4	251	234.3	90.0
12	11.2	04.3	72	67.2	25.8	32	123.2	47.3	92	179.2	68.8	52	235.3	90.3
13	12.1	04.7	73	68.2	26.2	33	124.2	47.7	93	180.2	69.2	53	236.2	90.7
14	13.1	05.0	74	69.1	26.5	34	125.1	48.0	94	181.1	69.5	54	237.1	91.0
15	14.0	05.4	75	70.0	26.9	35	126.0	48.4	95	182.0	69.9	55	238.1	91.4
16	14.9	05.7	76	70.9	27.2	36	127.0	48.7	96	183.0	70.2	56	239.0	91.7
17	15.9	06.1	77	71.9	27.6	37	127.9	49.1	97	183.9	70.6	57	239.9	92.1
18	16.8	06.5	78	72.8	28.0	38	128.8	49.5	98	184.8	71.0	58	240.9	92.5
19	17.7	06.8	79	73.8	28.3	39	129.8	49.8	99	185.8	71.3	59	241.8	92.8
20	18.7	07.2	80	74.7	28.7	40	130.7	50.2	200	186.7	71.7	60	242.7	93.2
21	19.6	07.5	81	75.6	29.0	141	131.6	50.5	201	187.6	72.0	261	243.7	93.5
22	20.5	07.9	82	76.6	29.4	42	132.6	50.9	02	188.6	72.4	62	244.6	93.9
23	21.5	08.2	83	77.5	29.7	43	133.5	51.2	03	189.5	72.7	63	245.5	94.3
24	22.4	08.6	84	78.4	30.1	44	134.4	51.6	04	190.5	73.1	64	246.5	94.6
25	23.3	09.0	85	79.4	30.5	45	135.4	52.0	05	191.4	73.5	65	247.4	95.0
26	24.3	09.3	86	80.3	30.8	46	136.3	52.3	06	192.3	73.8	66	248.3	95.3
27	25.2	09.7	87	81.2	31.2	47	137.2	52.7	07	193.3	74.2	67	249.3	95.7
28	26.1	10.0	88	82.2	31.5	48	138.2	53.0	08	194.2	74.5	68	250.2	96.0
29	27.1	10.4	89	83.1	31.9	49	139.1	53.4	09	195.1	74.9	69	251.1	96.4
30	28.0	10.8	90	84.0	32.3	50	140.0	53.8	10	196.1	75.3	70	252.1	96.8
31	28.9	11.1	91	85.0	32.6	151	141.0	54.1	211	197.0	75.6	271	253.0	97.1
32	29.9	11.5	92	85.9	33.0	52	141.9	54.5	12	197.9	76.0	72	253.9	97.5
33	30.8	11.8	93	86.8	33.3	53	142.8	54.8	13	198.9	76.3	73	254.9	97.8
34	31.7	12.2	94	87.8	33.7	54	143.8	55.2	14	199.8	76.7	74	255.8	98.2
35	32.7	12.5	95	88.7	34.0	55	144.7	55.5	15	200.7	77.0	75	256.7	98.6
36	33.6	12.9	96	89.6	34.4	56	145.6	55.9	16	201.7	77.4	76	257.7	98.9
37	34.5	13.3	97	90.6	34.8	57	146.6	56.3	17	202.6	77.8	77	258.6	99.3
38	35.5	13.6	98	91.5	35.1	58	147.5	56.6	18	203.5	78.1	78	259.5	99.6
39	36.4	14.0	99	92.4	35.5	59	148.4	57.0	19	204.5	78.5	79	260.5	100.0
40	37.3	14.3	100	93.4	35.8	60	149.4	57.3	20	205.4	78.8	80	261.4	100.3
41	38.3	14.7	101	94.3	36.2	161	150.3	57.7	221	206.3	79.2	281	262.3	100.7
42	39.2	15.1	02	95.2	36.6	62	151.2	58.1	22	207.3	79.6	82	263.3	101.1
43	40.1	15.4	03	96.2	36.9	63	152.2	58.4	23	208.2	79.9	83	264.2	101.4
44	41.1	15.8	04	97.1	37.3	64	153.1	58.8	24	209.1	80.3	84	265.1	101.8
45	42.0	16.1	05	98.0	37.6	65	154.0	59.1	25	210.1	80.6	85	266.1	102.1
46	42.9	16.5	06	99.0	38.0	66	155.0	59.5	26	211.0	81.0	86	267.0	102.5
47	43.9	16.8	07	99.9	38.3	67	155.9	59.8	27	211.9	81.3	87	267.9	102.9
48	44.8	17.2	08	100.8	38.7	68	156.8	60.2	28	212.9	81.7	88	268.9	103.2
49	45.7	17.6	09	101.8	39.1	69	157.8	60.6	29	213.8	82.1	89	269.8	103.6
50	46.7	17.9	10	102.7	39.4	70	158.7	60.9	30	214.7	82.4	90	260.7	103.9
51	47.6	18.3	111	103.6	39.8	171	159.6	61.3	231	215.7	82.8	291	271.7	104.3
52	48.5	18.6	12	104.6	40.1	72	160.6	61.6	32	216.6	83.1	92	272.6	104.6
53	49.5	19.0	13	105.5	40.5	73	161.5	62.0	33	217.5	83.5	93	273.5	105.0
54	50.4	19.4	14	106.4	40.9	74	162.4	62.4	34	218.5	83.9	94	274.5	105.4
55	51.3	19.7	15	107.4	41.2	75	163.4	62.7	35	219.4	84.2	95	275.4	105.7
56	52.3	20.1	16	108.3	41.6	76	164.3	63.1	36	220.3	84.6	96	276.3	106.1
57	53.2	20.4	17	109.2	41.9	77	165.2	63.4	37	221.3	84.9	97	277.3	106.4
58	54.1	20.8	18	110.2	42.3	78	166.2	63.8	38	222.2	85.3	98	278.2	106.8
59	55.1	21.1	19	111.1	42.6	79	167.1	64.1	39	223.1	85.6	99	279.1	107.2
60	56.0	21.5	20	112.0	43.0	80	168.0	64.5	40	224.1	86.0	300	280.1	107.5
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

for 69 Degrees

Table II. Difference of Latitude and Departure for 22 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.4	61	56.6	22.9	121	112.2	45.3	181	167.8	67.8	241	223.5	90.3
2	01.9	00.7	62	57.5	23.2	22	113.1	45.7	82	168.7	68.2	42	224.4	90.7
3	02.8	01.1	63	58.4	23.6	23	114.0	46.1	83	169.7	68.6	43	225.3	91.0
4	03.7	01.5	64	59.3	24.0	24	115.0	46.5	84	170.6	68.9	44	226.2	91.4
5	04.6	01.9	65	60.3	24.3	25	115.9	46.8	85	171.5	69.3	45	227.2	91.8
6	05.6	02.2	66	61.2	24.7	26	116.8	47.2	86	172.5	69.7	46	228.1	92.2
7	06.5	02.6	67	62.1	25.1	27	117.8	47.6	87	173.4	70.1	47	229.0	92.5
8	07.4	03.0	68	63.0	25.5	28	118.7	47.9	88	174.3	70.4	48	229.9	92.9
9	08.3	03.4	69	64.0	25.8	29	119.6	48.3	89	175.2	70.8	49	230.9	93.3
10	09.3	03.7	70	64.9	26.2	30	120.5	48.7	90	176.2	71.2	50	231.8	93.7
11	10.2	04.1	71	65.8	26.6	131	121.5	49.1	191	177.1	71.5	251	232.7	94.0
12	11.1	04.5	72	66.8	27.0	32	122.4	49.4	92	178.0	71.9	52	233.7	94.4
13	12.1	04.9	73	67.7	27.3	33	123.3	49.8	93	178.9	72.3	53	234.6	94.8
14	13.0	05.2	74	68.6	27.7	34	124.2	50.2	94	179.9	72.7	54	235.5	95.2
15	13.9	05.6	75	69.5	28.1	35	125.2	50.6	95	180.8	73.0	55	236.4	95.5
16	14.8	06.0	76	70.5	28.5	36	126.1	50.9	96	181.7	73.4	56	237.4	95.9
17	15.8	06.4	77	71.4	28.8	37	127.0	51.3	97	182.7	73.8	57	238.3	96.3
18	16.7	06.7	78	72.3	29.2	38	128.0	51.7	98	183.6	74.2	58	239.2	96.6
19	17.6	07.1	79	73.2	29.6	39	128.9	52.1	99	184.5	74.5	59	240.1	97.0
20	18.5	07.5	80	74.2	30.0	40	129.8	52.4	200	185.4	74.9	60	241.1	97.4
21	19.5	07.9	81	75.1	30.3	141	130.7	52.8	201	186.4	75.3	261	242.0	97.8
22	20.4	08.2	82	76.0	30.7	42	131.7	53.2	02	187.3	75.7	62	242.9	98.1
23	21.3	08.6	83	77.0	31.1	43	132.6	53.6	03	188.2	76.0	63	243.8	98.5
24	22.3	09.0	84	77.9	31.5	44	133.5	53.9	04	189.1	76.4	64	244.8	98.9
25	23.2	09.4	85	78.8	31.8	45	134.4	54.3	05	190.1	76.8	65	245.7	99.3
26	24.1	09.7	86	79.7	32.2	46	135.4	54.7	06	191.0	77.2	66	246.6	99.6
27	25.0	10.1	87	80.7	32.6	47	136.3	55.1	07	191.9	77.5	67	247.6	100.0
28	26.0	10.5	88	81.6	33.0	48	137.2	55.4	08	192.9	77.9	68	248.5	100.4
29	26.9	10.9	89	82.5	33.3	49	138.2	55.8	09	193.8	78.3	69	249.4	100.8
30	27.8	11.2	90	83.4	33.7	50	139.1	56.2	10	194.7	78.7	70	250.3	101.1
31	28.7	11.6	91	84.4	34.1	151	140.0	56.6	211	195.6	79.0	271	251.3	101.5
32	29.7	12.0	92	85.3	34.5	52	140.9	56.9	12	196.6	79.4	72	252.2	101.9
33	30.6	12.4	93	86.2	34.8	53	141.9	57.3	13	197.5	79.8	73	253.1	102.3
34	31.5	12.7	94	87.2	35.2	54	142.8	57.7	14	198.4	80.2	74	254.1	102.6
35	32.5	13.1	95	88.1	35.6	55	143.7	58.1	15	199.3	80.5	75	255.0	103.0
36	33.4	13.5	96	89.0	36.0	56	144.6	58.4	16	200.3	80.9	76	255.9	103.4
37	34.3	13.9	97	89.9	36.3	57	145.6	58.8	17	201.2	81.3	77	256.8	103.8
38	35.2	14.2	98	90.9	36.7	58	146.5	59.2	18	202.1	81.7	78	257.8	104.1
39	36.2	14.6	99	91.8	37.1	59	147.4	59.6	19	203.1	82.0	79	258.7	104.5
40	37.1	15.0	100	92.7	37.5	60	148.3	59.9	20	204.0	82.4	80	259.6	104.9
41	38.0	15.4	101	93.6	37.8	161	149.3	60.3	221	204.9	82.8	281	260.5	105.3
42	38.9	15.7	02	94.6	38.2	62	150.2	60.7	22	205.8	83.2	82	261.5	105.6
43	39.9	16.1	03	95.5	38.6	63	151.1	61.1	23	206.8	83.5	83	262.4	106.0
44	40.8	16.5	04	96.4	39.0	64	152.1	61.4	24	207.7	83.9	84	263.3	106.4
45	41.7	16.9	05	97.4	39.3	65	153.0	61.8	25	208.6	84.3	85	264.2	106.8
46	42.7	17.2	06	98.3	39.7	66	153.9	62.2	26	209.5	84.7	86	265.2	107.1
47	43.6	17.6	07	99.2	40.1	67	154.8	62.6	27	210.5	85.0	87	266.1	107.5
48	44.5	18.0	08	100.1	40.5	68	155.8	62.9	28	211.4	85.4	88	267.0	107.9
49	45.4	18.4	09	101.1	40.8	69	156.7	63.3	29	212.3	85.8	89	268.0	108.3
50	46.4	18.7	10	102.0	41.2	70	157.6	63.7	30	213.3	86.2	90	268.9	108.6
51	47.3	19.1	111	102.9	41.6	171	158.5	64.1	231	214.2	86.5	291	269.8	109.0
52	48.2	19.5	12	103.8	42.0	72	159.5	64.4	32	215.1	86.9	92	270.7	109.4
53	49.1	19.9	13	104.8	42.3	73	160.4	64.8	33	216.0	87.3	93	271.7	109.8
54	50.1	20.2	14	105.7	42.7	74	161.3	65.2	34	217.0	87.7	94	272.6	110.1
55	51.0	20.6	15	106.6	43.1	75	162.3	65.6	35	217.9	88.0	95	273.5	110.5
56	51.9	21.0	16	107.6	43.5	76	163.2	65.9	36	218.8	88.4	96	274.4	110.9
57	52.8	21.4	17	108.5	43.9	77	164.1	66.3	37	219.7	88.8	97	275.4	111.3
58	53.8	21.7	18	109.4	44.2	78	165.0	66.7	38	220.7	89.2	98	276.3	111.6
59	54.7	22.1	19	110.3	44.6	79	166.0	67.1	39	221.6	89.5	99	277.2	112.0
60	55.6	22.5	20	111.3	45.0	80	166.9	67.4	40	222.5	89.9	300	278.2	112.4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 68 Degrees.

Table II. Difference of Latitude and Departure for 23 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.4	61	56.2	23.8	121	111.4	47.3	181	166.6	70.7	241	221.8	94.2
2	01.8	00.8	62	57.1	24.2	22	112.3	47.7	82	167.5	71.1	42	222.8	94.5
3	02.8	01.2	63	58.0	24.6	23	113.2	48.1	83	168.5	71.5	43	223.7	94.9
4	03.7	01.6	64	58.9	25.0	24	114.1	48.5	84	169.4	71.9	44	224.6	95.3
5	04.6	02.0	65	59.8	25.4	25	115.1	48.8	85	170.3	72.3	45	225.5	95.7
6	05.5	02.3	66	60.8	25.8	26	116.0	49.2	86	171.2	72.7	46	226.4	96.1
7	06.4	02.7	67	61.7	26.2	27	116.9	49.6	87	172.1	73.1	47	227.4	96.5
8	07.4	03.1	68	62.6	26.6	28	117.8	50.0	88	173.1	73.5	48	228.3	96.9
9	08.3	03.5	69	63.5	27.0	29	118.7	50.4	89	174.0	73.8	49	229.2	97.3
10	09.2	03.9	70	64.4	27.4	30	119.7	50.8	90	174.9	74.2	50	230.1	97.7
11	10.1	04.3	71	65.4	27.7	131	120.6	51.2	191	175.8	74.6	251	231.0	98.1
12	11.0	04.7	72	66.3	28.1	32	121.5	51.6	92	176.7	75.0	52	232.0	98.5
13	12.0	05.1	73	67.2	28.5	33	122.4	52.0	93	177.7	75.4	53	232.9	98.9
14	12.9	05.5	74	68.1	28.9	34	123.3	52.4	94	178.6	75.8	54	233.8	99.2
15	13.8	05.9	75	69.0	29.3	35	124.3	52.7	95	179.5	76.2	55	234.7	99.6
16	14.7	06.3	76	70.0	29.7	36	125.2	53.1	96	180.4	76.6	56	235.6	100.0
17	15.6	06.6	77	70.9	30.1	37	126.1	53.5	97	181.3	77.0	57	236.6	100.4
18	16.6	07.0	78	71.8	30.5	38	127.0	53.9	98	182.3	77.4	58	237.5	100.8
19	17.5	07.4	79	72.7	30.9	39	128.0	54.3	99	183.2	77.8	59	238.4	101.2
20	18.4	07.8	80	73.6	31.3	40	128.9	54.7	200	184.1	78.1	60	239.3	101.6
21	19.3	08.2	81	74.6	31.6	141	129.8	55.1	201	185.0	78.5	261	240.3	102.0
22	20.3	08.6	82	75.5	32.0	42	130.7	55.5	02	185.9	78.9	62	241.2	102.4
23	21.2	09.0	83	76.4	32.4	43	131.6	55.9	03	186.9	79.3	63	242.1	102.8
24	22.1	09.4	84	77.3	32.8	44	132.6	56.3	04	187.8	79.7	64	243.0	103.2
25	23.0	09.8	85	78.2	33.2	45	133.5	56.7	05	188.7	80.1	65	243.9	103.5
26	23.9	10.2	86	79.2	33.6	46	134.4	57.0	06	189.6	80.5	66	244.9	103.9
27	24.9	10.5	87	80.1	34.0	47	135.3	57.4	07	190.5	80.9	67	245.8	104.3
28	25.8	10.9	88	81.0	34.4	48	136.2	57.8	08	191.5	81.3	68	246.7	104.7
29	26.7	11.3	89	81.9	34.8	49	137.2	58.2	09	192.4	81.7	69	247.6	105.1
30	27.6	11.7	90	82.8	35.2	50	138.1	58.6	10	193.3	82.1	70	248.5	105.5
31	28.5	12.1	91	83.8	35.6	151	139.0	59.0	211	194.2	82.4	271	249.5	105.9
32	29.5	12.5	92	84.7	35.9	52	139.9	59.4	12	195.1	82.8	72	250.4	106.3
33	30.4	12.9	93	85.6	36.3	53	140.8	59.8	13	196.1	83.2	73	251.3	106.7
34	31.3	13.3	94	86.5	36.7	54	141.8	60.2	14	197.0	83.6	74	252.2	107.1
35	32.2	13.7	95	87.4	37.1	55	142.7	60.6	15	197.9	84.0	75	253.1	107.5
36	33.1	14.1	96	88.4	37.5	56	143.6	61.0	16	198.8	84.4	76	254.1	107.8
37	34.1	14.5	97	89.3	37.9	57	144.5	61.3	17	199.7	84.8	77	255.0	108.2
38	35.0	14.8	98	90.2	38.3	58	145.4	61.7	18	200.7	85.2	78	255.9	108.6
39	35.9	15.2	99	91.1	38.7	59	146.4	62.1	19	201.6	85.6	79	256.8	109.0
40	36.8	15.6	100	92.1	39.1	60	147.3	62.5	20	202.5	86.0	80	257.7	109.4
41	37.7	16.0	101	93.0	39.5	161	148.2	62.9	221	203.4	86.4	281	258.7	109.8
42	38.7	16.4	02	93.9	39.9	62	149.1	63.3	22	204.4	86.7	82	259.6	110.2
43	39.6	16.8	03	94.8	40.2	63	150.0	63.7	23	205.3	87.1	83	260.5	110.6
44	40.5	17.2	04	95.7	40.6	64	151.0	64.1	24	206.2	87.5	84	261.4	111.0
45	41.4	17.6	05	96.7	41.0	65	151.9	64.5	25	207.1	87.9	85	262.3	111.4
46	42.3	18.0	06	97.6	41.4	66	152.8	64.9	26	208.0	88.3	86	263.3	111.7
47	43.3	18.4	07	98.5	41.8	67	153.7	65.3	27	209.0	88.7	87	264.2	112.1
48	44.2	18.8	08	99.4	42.2	68	154.6	65.6	28	209.9	89.1	88	265.1	112.5
49	45.1	19.1	09	100.3	42.6	69	155.6	66.0	29	210.8	89.5	89	266.0	112.9
50	46.0	19.5	10	101.3	43.0	70	156.5	66.4	30	211.7	89.9	90	266.9	113.3
51	46.9	19.9	111	102.2	43.4	171	157.4	66.8	231	212.6	90.3	291	267.9	113.7
52	47.9	20.3	12	103.1	43.8	72	158.3	67.2	32	213.6	90.6	92	268.8	114.1
53	48.8	20.7	13	104.0	44.2	73	159.2	67.6	33	214.5	91.0	93	269.7	114.5
54	49.7	21.1	14	104.9	44.5	74	160.2	68.0	34	215.4	91.4	94	270.6	114.9
55	50.6	21.5	15	105.9	44.9	75	161.1	68.4	35	216.3	91.8	95	271.5	115.3
56	51.5	21.9	16	106.8	45.3	76	162.0	68.8	36	217.2	92.2	96	272.5	115.7
57	52.5	22.3	17	107.7	45.7	77	162.9	69.2	37	218.2	92.6	97	273.4	116.0
58	53.4	22.7	18	108.6	46.1	78	163.8	69.6	38	219.1	93.0	98	274.3	116.4
59	54.3	23.1	19	109.5	46.5	79	164.8	69.9	39	220.0	93.4	99	275.2	116.8
60	55.2	23.4	20	110.5	46.9	80	165.7	70.3	40	220.9	93.8	300	276.2	117.2
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 67 Degrees.

TABLE II. Difference of Latitude and Departure for 24 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.4	61	55.7	24.8	121	110.5	49.2	181	165.4	73.6	241	220.2	98.0
2	01.8	00.8	62	56.6	25.2	22	111.5	49.6	82	166.3	74.0	42	221.1	98.4
3	02.7	01.2	63	57.6	25.6	23	112.4	50.0	83	167.2	74.4	43	222.0	98.8
4	03.7	01.6	64	58.5	26.0	24	113.3	50.4	84	168.1	74.8	44	222.9	99.2
5	04.6	02.0	65	59.4	26.4	25	114.2	50.8	85	169.0	75.2	45	223.8	99.7
6	05.5	02.4	66	60.3	26.8	26	115.1	51.2	86	169.9	75.7	46	224.7	100.1
7	06.4	02.8	67	61.2	27.3	27	116.0	51.7	87	170.8	76.1	47	225.6	100.5
8	07.3	03.3	68	62.1	27.7	28	116.9	52.1	88	171.7	76.5	48	226.6	100.9
9	08.2	03.7	69	63.0	28.1	29	117.8	52.5	89	172.7	76.9	49	227.5	101.3
10	09.1	04.1	70	63.9	28.5	30	118.8	52.9	90	173.6	77.3	50	228.4	101.7
11	10.0	04.5	71	64.9	28.9	131	119.7	53.3	191	174.5	77.7	251	229.3	102.1
12	11.0	04.9	72	65.8	29.3	32	120.6	53.7	92	175.4	78.1	52	230.2	102.5
13	11.9	05.3	73	66.7	29.7	33	121.5	54.1	93	176.3	78.5	53	231.1	102.9
14	12.8	05.7	74	67.6	30.1	34	122.4	54.5	94	177.2	78.9	54	232.0	103.3
15	13.7	06.1	75	68.5	30.5	35	123.3	54.9	95	178.1	79.3	55	233.0	103.7
16	14.6	06.5	76	69.4	30.9	36	124.2	55.3	96	179.1	79.7	56	233.9	104.1
17	15.5	06.9	77	70.3	31.3	37	125.2	55.7	97	180.0	80.1	57	234.8	104.5
18	16.4	07.3	78	71.3	31.7	38	126.1	56.1	98	180.9	80.5	58	235.7	104.9
19	17.4	07.7	79	72.2	32.1	39	127.0	56.5	99	181.8	80.9	59	236.6	105.3
20	18.3	08.1	80	73.1	32.5	40	127.9	56.9	200	182.7	81.3	60	237.5	105.8
21	19.2	08.5	81	74.0	32.9	141	128.8	57.3	201	183.6	81.8	261	238.4	106.2
22	20.1	08.9	82	74.9	33.4	42	129.7	57.8	02	184.5	82.2	62	239.3	106.6
23	21.0	09.4	83	75.8	33.8	43	130.6	58.2	03	185.4	82.6	63	240.3	107.0
24	21.9	09.8	84	76.7	34.2	44	131.6	58.6	04	186.4	83.0	64	241.2	107.4
25	22.8	10.2	85	77.7	34.6	45	132.5	59.0	05	187.3	83.4	65	242.1	107.8
26	23.8	10.6	86	78.6	35.0	46	133.4	59.4	06	188.2	83.8	66	243.0	108.2
27	24.7	11.0	87	79.5	35.4	47	134.3	59.8	07	189.1	84.2	67	243.9	108.6
28	25.6	11.4	88	80.4	35.8	48	135.2	60.2	08	190.0	84.6	68	244.8	109.0
29	26.5	11.8	89	81.3	36.2	49	136.1	60.6	09	190.9	85.0	69	245.7	109.4
30	27.4	12.2	90	82.2	36.6	50	137.0	61.0	10	191.8	85.4	70	246.7	109.8
31	28.3	12.6	91	83.1	37.0	151	137.9	61.4	211	192.8	85.8	271	247.6	110.2
32	29.2	13.0	92	84.0	37.4	52	138.9	61.8	12	193.7	86.2	72	248.5	110.6
33	30.1	13.4	93	85.0	37.8	53	139.8	62.2	13	194.6	86.6	73	249.4	111.0
34	31.1	13.8	94	85.9	38.2	54	140.7	62.6	14	195.5	87.0	74	250.3	111.4
35	32.0	14.2	95	86.8	38.6	55	141.6	63.0	15	196.4	87.4	75	251.2	111.9
36	32.9	14.6	96	87.7	39.0	56	142.5	63.5	16	197.3	87.9	76	252.1	112.3
37	33.8	15.0	97	88.6	39.5	57	143.4	63.9	17	198.2	88.3	77	253.1	112.7
38	34.7	15.5	98	89.5	39.9	58	144.3	64.3	18	199.2	88.7	78	254.0	113.1
39	35.6	15.9	99	90.4	40.3	59	145.3	64.7	19	200.1	89.1	79	254.9	113.5
40	36.5	16.3	100	91.4	40.7	60	146.2	65.1	20	201.0	89.5	80	255.8	113.9
41	37.5	16.7	101	92.3	41.1	161	147.1	65.5	221	201.9	89.9	281	256.7	114.3
42	38.4	17.1	02	93.2	41.5	62	148.0	65.9	22	202.8	90.3	82	257.6	114.7
43	39.3	17.5	03	94.1	41.9	63	148.9	66.3	23	203.7	90.7	83	258.5	115.1
44	40.2	17.9	04	95.0	42.3	64	149.8	66.7	24	204.6	91.1	84	259.4	115.5
45	41.1	18.3	05	95.9	42.7	65	150.7	67.1	25	205.5	91.5	85	260.4	115.9
46	42.0	18.7	06	96.8	43.1	66	151.6	67.5	26	206.5	91.9	86	261.3	116.3
47	42.9	19.1	07	97.7	43.5	67	152.6	67.9	27	207.4	92.3	87	262.2	116.7
48	43.9	19.5	08	98.7	43.9	68	153.5	68.3	28	208.3	92.7	88	263.1	117.1
49	44.8	19.9	09	99.6	44.3	69	154.4	68.7	29	209.2	93.1	89	264.0	117.5
50	45.7	20.3	10	100.5	44.7	70	155.3	69.1	30	210.1	93.5	90	264.9	118.0
51	46.6	20.7	111	101.4	45.1	171	156.2	69.6	231	211.0	94.0	291	265.8	118.4
52	47.5	21.2	12	102.3	45.6	72	157.1	70.0	32	211.9	94.4	92	266.8	118.8
53	48.4	21.6	13	103.2	46.0	73	158.0	70.4	33	212.9	94.8	93	267.7	119.2
54	49.3	22.0	14	104.1	46.4	74	159.0	70.8	34	213.8	95.2	94	268.6	119.6
55	50.2	22.4	15	105.1	46.8	75	159.9	71.2	35	214.7	95.6	95	269.5	120.0
56	51.2	22.8	16	106.0	47.2	76	160.8	71.6	36	215.6	96.0	96	270.4	120.4
57	52.1	23.2	17	106.9	47.6	77	161.7	72.0	37	216.5	96.4	97	271.3	120.8
58	53.0	23.6	18	107.8	48.0	78	162.6	72.4	38	217.4	96.8	98	272.2	121.2
59	53.9	24.0	19	108.7	48.4	79	163.5	72.8	39	218.3	97.2	99	273.2	121.6
60	54.8	24.4	20	109.6	48.8	80	164.4	73.2	40	219.3	97.6	300	274.1	122.0
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 66 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.4	61	55.3	25.8	121	109.7	51.1	181	164.0	76.5	241	218.4	101.9
2	01.8	00.8	62	56.2	26.2	22	110.6	51.6	82	164.9	76.9	42	219.3	102.3
3	02.7	01.3	63	57.1	26.6	23	111.5	52.0	83	165.9	77.3	43	220.2	102.7
4	03.6	01.7	64	58.0	27.0	24	112.4	52.4	84	166.8	77.8	44	221.1	103.1
5	04.5	02.1	65	58.9	27.5	25	113.3	52.8	85	167.7	78.2	45	222.0	103.5
6	05.4	02.5	66	59.8	27.9	26	114.2	53.2	86	168.6	78.6	46	223.0	104.0
7	06.3	03.0	67	60.7	28.3	27	115.1	53.7	87	169.5	79.0	47	223.9	104.4
8	07.3	03.4	68	61.6	28.7	28	116.0	54.1	88	170.4	79.5	48	224.8	104.8
9	08.2	03.8	69	62.5	29.2	29	116.9	54.5	89	171.3	79.9	49	225.7	105.2
10	09.1	04.2	70	63.4	29.6	30	117.8	54.9	90	172.2	80.3	50	226.6	105.7
11	10.0	04.6	71	64.3	30.0	131	118.7	55.4	191	173.1	80.7	251	227.5	106.1
12	10.9	05.1	72	65.3	30.4	32	119.6	55.8	92	174.0	81.1	52	228.4	106.5
13	11.8	05.5	73	66.2	30.9	33	120.5	56.2	93	174.9	81.6	53	229.3	106.9
14	12.7	05.9	74	67.1	31.3	34	121.4	56.6	94	175.8	82.0	54	230.2	107.3
15	13.6	06.3	75	68.0	31.7	35	122.4	57.1	95	176.7	82.4	55	231.1	107.8
16	14.5	06.8	76	68.9	32.1	36	123.3	57.5	96	177.6	82.8	56	232.0	108.2
17	15.4	07.2	77	69.8	32.5	37	124.2	57.9	97	178.5	83.3	57	232.9	108.6
18	16.3	07.6	78	70.7	33.0	38	125.1	58.3	98	179.4	83.7	58	233.8	109.0
19	17.2	08.0	79	71.6	33.4	39	126.0	58.7	99	180.4	84.1	59	234.7	109.5
20	18.1	08.5	80	72.5	33.8	40	126.9	59.2	200	181.3	84.5	60	235.6	109.9
21	19.0	08.9	81	73.4	34.2	141	127.8	59.6	201	182.2	84.9	261	236.5	110.3
22	19.9	09.3	82	74.3	34.7	42	128.7	60.0	02	183.1	85.4	62	237.5	110.7
23	20.8	09.7	83	75.2	35.1	43	129.6	60.4	03	184.0	85.8	63	238.4	111.1
24	21.8	10.1	84	76.1	35.5	44	130.5	60.9	04	184.9	86.2	64	239.3	111.6
25	22.7	10.6	85	77.0	35.9	45	131.4	61.3	05	185.8	86.6	65	240.2	112.0
26	23.6	11.0	86	77.9	36.3	46	132.3	61.7	06	186.7	87.1	66	241.1	112.4
27	24.5	11.4	87	78.8	36.8	47	133.2	62.1	07	187.6	87.5	67	242.0	112.8
28	25.4	11.8	88	79.8	37.2	48	134.1	62.5	08	188.5	87.9	68	242.9	113.3
29	26.3	12.3	89	80.7	37.6	49	135.0	63.0	09	189.4	88.3	69	243.8	113.7
30	27.2	12.7	90	81.6	38.0	50	135.9	63.4	10	190.3	88.7	70	244.7	114.1
31	28.1	13.1	91	82.5	38.5	151	136.9	63.8	211	191.2	89.2	271	245.6	114.5
32	29.0	13.5	92	83.4	38.9	52	137.8	64.2	12	192.1	89.6	72	246.5	115.0
33	29.9	13.9	93	84.3	39.3	53	138.7	64.7	13	193.0	90.0	73	247.4	115.4
34	30.8	14.4	94	85.2	39.7	54	139.6	65.1	14	193.9	90.4	74	248.3	115.8
35	31.7	14.8	95	86.1	40.1	55	140.5	65.5	15	194.9	90.9	75	249.2	116.2
36	32.6	15.2	96	87.0	40.6	56	141.4	65.9	16	195.8	91.3	76	250.1	116.6
37	33.5	15.6	97	87.9	41.0	57	142.3	66.4	17	196.7	91.7	77	251.0	117.1
38	34.4	16.1	98	88.8	41.4	58	143.2	66.8	18	197.6	92.1	78	252.0	117.5
39	35.3	16.5	99	89.7	41.8	59	144.1	67.2	19	198.5	92.6	79	252.9	117.9
40	36.3	16.9	100	90.6	42.3	60	145.0	67.6	20	199.4	93.0	80	253.8	118.3
41	37.2	17.3	101	91.5	42.7	161	145.9	68.0	221	200.3	93.4	281	254.7	118.8
42	38.1	17.7	02	92.4	43.1	62	146.8	68.5	22	201.2	93.8	82	255.6	119.2
43	39.0	18.2	03	93.3	43.5	63	147.7	68.9	23	202.1	94.2	83	256.5	119.6
44	39.9	18.6	04	94.3	44.0	64	148.6	69.3	24	203.0	94.7	84	257.4	120.0
45	40.8	19.0	05	95.2	44.4	65	149.5	69.7	25	203.9	95.1	85	258.3	120.4
46	41.7	19.4	06	96.1	44.8	66	150.4	70.2	26	204.8	95.5	86	259.2	120.9
47	42.6	19.9	07	97.0	45.2	67	151.4	70.6	27	205.7	95.9	87	260.1	121.3
48	43.5	20.3	08	97.9	45.6	68	152.3	71.0	28	206.6	96.4	88	261.0	121.7
49	44.4	20.7	09	98.8	46.1	69	153.2	71.4	29	207.5	96.8	89	261.9	122.1
50	45.3	21.1	10	99.7	46.5	70	154.1	71.8	30	208.5	97.2	90	262.8	122.6
51	46.2	21.6	111	100.6	46.9	171	155.0	72.3	231	209.4	97.6	291	263.7	123.0
52	47.1	22.0	12	101.5	47.3	72	155.9	72.7	32	210.3	98.0	92	264.6	123.4
53	48.0	22.4	13	102.4	47.8	73	156.8	73.1	33	211.2	98.5	93	265.5	123.8
54	48.9	22.8	14	103.3	48.2	74	157.7	73.5	34	212.1	98.9	94	266.5	124.2
55	49.8	23.2	15	104.2	48.6	75	158.6	74.0	35	213.0	99.3	95	267.4	124.7
56	50.8	23.7	16	105.1	49.0	76	159.5	74.4	36	213.9	99.7	96	268.3	125.1
57	51.7	24.1	17	106.0	49.4	77	160.4	74.8	37	214.8	100.2	97	269.2	125.5
58	52.6	24.5	18	106.9	49.9	78	161.3	75.2	38	215.7	100.6	98	270.1	125.9
59	53.5	24.9	19	107.9	50.3	79	162.2	75.6	39	216.6	101.0	99	271.0	126.4
60	54.4	25.4	20	108.8	50.7	80	163.1	76.1	40	217.5	101.4	300	271.9	126.8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.4	61	54.8	26.7	121	108.8	53.0	181	162.7	79.3	241	216.6	105.6
2	01.8	00.9	62	55.7	27.2	22	109.7	53.5	82	163.6	79.8	42	217.5	106.1
3	02.7	01.3	63	56.6	27.6	23	110.6	53.9	83	164.5	80.2	43	218.4	106.5
4	03.6	01.8	64	57.5	28.1	24	111.5	54.4	84	165.4	80.7	44	219.3	107.0
5	04.5	02.2	65	58.4	28.5	25	112.3	54.8	85	166.3	81.1	45	220.2	107.4
6	05.4	02.6	66	59.3	28.9	26	113.2	55.2	86	167.2	81.5	46	221.1	107.8
7	06.3	03.1	67	60.2	29.4	27	114.1	55.7	87	168.1	82.0	47	222.0	108.3
8	07.2	03.5	68	61.1	29.8	28	115.0	56.1	88	169.0	82.4	48	222.9	108.7
9	08.1	03.9	69	62.0	30.2	29	115.9	56.5	89	169.9	82.9	49	223.8	109.2
10	09.0	04.4	70	62.9	30.7	30	116.8	57.0	90	170.8	83.3	50	224.7	109.6
11	09.9	04.8	71	63.8	31.1	131	117.7	57.4	191	171.7	83.7	251	225.6	110.0
12	10.8	05.3	72	64.7	31.6	32	118.6	57.9	92	172.6	84.2	52	226.5	110.5
13	11.7	05.7	73	65.6	32.0	33	119.5	58.3	93	173.5	84.6	53	227.4	110.9
14	12.6	06.1	74	66.5	32.4	34	120.4	58.7	94	174.4	85.0	54	228.3	111.3
15	13.5	06.6	75	67.4	32.9	35	121.3	59.2	95	175.3	85.5	55	229.2	111.8
16	14.4	07.0	76	68.3	33.3	36	122.2	59.6	96	176.2	85.9	56	230.1	112.2
17	15.3	07.5	77	69.2	33.8	37	123.1	60.1	97	177.1	86.4	57	231.0	112.7
18	16.2	07.9	78	70.1	34.2	38	124.0	60.5	98	178.0	86.8	58	231.9	113.1
19	17.1	08.3	79	71.0	34.6	39	124.9	60.9	99	178.9	87.2	59	232.8	113.5
20	18.0	08.8	80	71.9	35.1	40	125.8	61.4	200	179.8	87.7	60	233.7	114.0
21	18.9	09.2	81	72.8	35.5	141	126.7	61.8	201	180.7	88.1	261	234.6	114.4
22	19.8	09.6	82	73.7	35.9	42	127.6	62.2	02	181.6	88.6	62	235.5	114.9
23	20.7	10.1	83	74.6	36.4	43	128.5	62.7	03	182.5	89.0	63	236.4	115.3
24	21.6	10.5	84	75.5	36.8	44	129.4	63.1	04	183.4	89.4	64	237.3	115.7
25	22.5	11.0	85	76.4	37.3	45	130.3	63.6	05	184.3	89.9	65	238.2	116.2
26	23.4	11.4	86	77.3	37.7	46	131.2	64.0	06	185.2	90.3	66	239.1	116.6
27	24.3	11.8	87	78.2	38.1	47	132.1	64.4	07	186.1	90.7	67	240.0	117.0
28	25.2	12.3	88	79.1	38.6	48	133.0	64.9	08	186.9	91.2	68	240.9	117.5
29	26.1	12.7	89	80.0	39.0	49	133.9	65.3	09	187.8	91.6	69	241.8	117.9
30	27.0	13.2	90	80.9	39.5	50	134.8	65.8	10	188.7	92.1	70	242.7	118.4
31	27.9	13.6	91	81.8	39.9	151	135.7	66.2	211	189.6	92.5	271	243.6	118.8
32	28.8	14.0	92	82.7	40.3	52	136.6	66.6	12	190.5	92.9	72	244.5	119.2
33	29.7	14.5	93	83.6	40.8	53	137.5	67.1	13	191.4	93.4	73	245.4	119.7
34	30.6	14.9	94	84.5	41.2	54	138.4	67.5	14	192.3	93.8	74	246.3	120.1
35	31.5	15.3	95	85.4	41.6	55	139.3	67.9	15	193.2	94.2	75	247.2	120.6
36	32.4	15.8	96	86.3	42.1	56	140.2	68.4	16	194.1	94.7	76	248.1	121.0
37	33.3	16.2	97	87.2	42.5	57	141.1	68.8	17	195.0	95.1	77	249.0	121.4
38	34.2	16.7	98	88.1	43.0	58	142.0	69.3	18	195.9	95.6	78	249.9	121.9
39	35.1	17.1	99	89.0	43.4	59	142.9	69.7	19	196.8	96.0	79	250.8	122.3
40	36.0	17.5	100	89.9	43.8	60	143.8	70.1	20	197.7	96.4	80	251.7	122.7
41	36.9	18.0	101	90.8	44.3	161	144.7	70.6	221	198.6	96.9	281	252.6	123.2
42	37.7	18.4	02	91.7	44.7	62	145.6	71.0	22	199.5	97.3	82	253.5	123.6
43	38.6	18.8	03	92.6	45.2	63	146.5	71.5	23	200.4	97.8	83	254.4	124.1
44	39.5	19.3	04	93.5	45.6	64	147.4	71.9	24	201.3	98.2	84	255.3	124.5
45	40.4	19.7	05	94.4	46.0	65	148.3	72.3	25	202.2	98.6	85	256.2	124.9
46	41.3	20.2	06	95.3	46.5	66	149.2	72.8	26	203.1	99.1	86	257.1	125.4
47	42.2	20.6	07	96.2	46.9	67	150.1	73.2	27	204.0	99.5	87	258.0	125.8
48	43.1	21.0	08	97.1	47.3	68	151.0	73.6	28	204.9	99.9	88	258.9	126.3
49	44.0	21.5	09	98.0	47.8	69	151.9	74.1	29	205.8	100.4	89	259.8	126.7
50	44.9	21.9	10	98.9	48.2	70	152.8	74.5	30	206.7	100.8	90	260.7	127.1
51	45.8	22.4	111	99.8	48.7	171	153.7	75.0	231	207.6	101.3	291	261.5	127.6
52	46.7	22.8	12	100.7	49.1	72	154.6	75.4	32	208.5	101.7	92	262.4	128.0
53	47.6	23.2	13	101.6	49.5	73	155.5	75.8	33	209.4	102.1	93	263.3	128.4
54	48.5	23.7	14	102.5	50.0	74	156.4	76.3	34	210.3	102.6	94	254.2	128.9
55	49.4	24.1	15	103.4	50.4	75	157.3	76.7	35	211.2	103.0	95	265.1	129.3
56	50.3	24.5	16	104.3	50.9	76	158.2	77.2	36	212.1	103.5	96	266.0	129.8
57	51.2	25.0	17	105.2	51.3	77	159.1	77.6	37	213.0	103.9	97	266.9	130.2
58	52.1	25.4	18	106.1	51.7	78	160.0	78.0	38	213.9	104.3	98	267.8	130.6
59	53.0	25.9	19	107.0	52.2	79	160.9	78.5	39	214.8	104.8	99	268.7	131.1
60	53.9	26.3	20	107.9	52.6	80	161.8	78.9	40	215.7	105.2	300	269.6	131.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 64 Degrees.

TABLE II. Difference of Latitude and Departure for 27 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.5	61	54.4	27.7	121	107.8	54.9	181	161.3	82.2	241	214.7	109.4
2	01.8	00.9	62	55.2	28.1	22	108.7	55.4	82	162.2	82.6	42	215.6	109.9
3	02.7	01.4	63	56.1	28.6	23	109.6	55.8	83	163.1	83.1	43	216.5	110.3
4	03.6	01.8	64	57.0	29.1	24	110.5	56.3	84	163.9	83.5	44	217.4	110.8
5	04.5	02.3	65	57.9	29.5	25	111.4	56.7	85	164.8	84.0	45	218.3	111.2
6	05.3	02.7	66	58.8	30.0	26	112.3	57.2	86	165.7	84.4	46	219.2	111.7
7	06.2	03.2	67	59.7	30.4	27	113.2	57.7	87	166.6	84.9	47	220.1	112.1
8	07.1	03.6	68	60.6	30.9	28	114.0	58.1	88	167.5	85.4	48	221.0	112.6
9	08.0	04.1	69	61.5	31.3	29	114.9	58.6	89	168.4	85.8	49	221.9	113.0
10	08.9	04.5	70	62.4	31.8	30	115.8	59.0	90	169.3	86.3	50	222.8	113.5
11	09.8	05.0	71	63.3	32.2	131	116.7	59.5	191	170.2	86.7	251	223.6	114.0
12	10.7	05.4	72	64.2	32.7	32	117.6	59.9	92	171.1	87.2	52	224.5	114.4
13	11.6	05.9	73	65.0	33.1	33	118.5	60.4	93	172.0	87.6	53	225.4	114.9
14	12.5	06.4	74	65.9	33.6	34	119.4	60.8	94	172.9	88.1	54	226.3	115.3
15	13.4	06.8	75	66.8	34.0	35	120.3	61.3	95	173.7	88.5	55	227.2	115.8
16	14.3	07.3	76	67.7	34.5	36	121.2	61.7	96	174.6	89.0	56	228.1	116.2
17	15.1	07.7	77	68.6	35.0	37	122.1	62.2	97	175.5	89.4	57	229.0	116.7
18	16.0	08.2	78	69.5	35.4	38	123.0	62.7	98	176.4	89.9	58	229.9	117.1
19	16.9	08.6	79	70.4	35.9	39	123.8	63.1	99	177.3	90.3	59	230.8	117.6
20	17.8	09.1	80	71.3	36.3	40	124.7	63.6	200	178.2	90.8	60	231.7	118.0
21	18.7	09.5	81	72.2	36.8	141	125.6	64.0	201	179.1	91.3	261	232.6	118.5
22	19.6	10.0	82	73.1	37.2	42	126.5	64.5	02	180.0	91.7	62	233.4	118.9
23	20.5	10.4	83	74.0	37.7	43	127.4	64.9	03	180.9	92.2	63	234.3	119.4
24	21.4	10.9	84	74.8	38.1	44	128.3	65.4	04	181.8	92.6	64	235.2	119.9
25	22.3	11.3	85	75.7	38.6	45	129.2	65.8	05	182.7	93.1	65	236.1	120.3
26	23.2	11.8	86	76.6	39.0	46	130.1	66.3	06	183.5	93.5	66	237.0	120.8
27	24.1	12.3	87	77.5	39.5	47	131.0	66.7	07	184.4	94.0	67	237.9	121.2
28	24.9	12.7	88	78.4	40.0	48	131.9	67.2	08	185.3	94.4	68	238.8	121.7
29	25.8	13.2	89	79.3	40.4	49	132.8	67.6	09	186.2	94.9	69	239.7	122.1
30	26.7	13.6	90	80.2	40.9	50	133.7	68.1	10	187.1	95.3	70	240.6	122.6
31	27.6	14.1	91	81.1	41.3	151	134.5	68.6	211	188.0	95.8	271	241.5	123.0
32	28.5	14.5	92	82.0	41.8	52	135.4	69.0	12	188.9	96.2	72	242.4	123.5
33	29.4	15.0	93	82.9	42.2	53	136.3	69.5	13	189.8	96.7	73	243.2	123.9
34	30.3	15.4	94	83.8	42.7	54	137.2	69.9	14	190.7	97.2	74	244.1	124.4
35	31.2	15.9	95	84.6	43.1	55	138.1	70.4	15	191.6	97.6	75	245.0	124.8
36	32.1	16.3	96	85.5	43.6	56	139.0	70.8	16	192.5	98.1	76	245.9	125.3
37	33.0	16.8	97	86.4	44.0	57	139.9	71.3	17	193.3	98.5	77	246.8	125.8
38	33.9	17.3	98	87.3	44.5	58	140.8	71.7	18	194.2	99.0	78	247.7	126.2
39	34.7	17.7	99	88.2	44.9	59	141.7	72.2	19	195.1	99.4	79	248.6	126.7
40	35.6	18.2	100	89.1	45.4	60	142.6	72.6	20	196.0	99.9	80	249.5	127.1
41	36.5	18.6	101	90.0	45.9	161	143.5	73.1	221	196.9	100.3	281	250.4	127.6
42	37.4	19.1	02	90.9	46.3	62	144.3	73.5	22	197.8	100.8	82	251.3	128.0
43	38.3	19.5	03	91.8	46.8	63	145.2	74.0	23	198.7	101.2	83	252.2	128.5
44	39.2	20.0	04	92.7	47.2	64	146.1	74.5	24	199.6	101.7	84	253.0	128.9
45	40.1	20.4	05	93.6	47.7	65	147.0	74.9	25	200.5	102.1	85	253.9	129.4
46	41.0	20.9	06	94.4	48.1	66	147.9	75.4	26	201.4	102.6	86	254.8	129.8
47	41.9	21.3	07	95.3	48.6	67	148.8	75.8	27	202.3	103.1	87	255.7	130.3
48	42.8	21.8	08	96.2	49.0	68	149.7	76.3	28	203.1	103.5	88	256.6	130.7
49	43.7	22.2	09	97.1	49.5	69	150.6	76.7	29	204.0	104.0	89	257.5	131.2
50	44.6	22.7	10	98.0	49.9	70	151.5	77.2	30	204.9	104.4	90	258.4	131.7
51	45.4	23.2	111	98.9	50.4	171	152.4	77.6	231	205.8	104.9	291	259.3	132.1
52	46.3	23.6	12	99.8	50.8	72	153.3	78.1	32	206.7	105.3	92	260.2	132.6
53	47.2	24.1	13	100.7	51.3	73	154.1	78.5	33	207.6	105.8	93	261.1	133.0
54	48.1	24.5	14	101.6	51.8	74	155.0	79.0	34	208.5	106.2	94	262.0	133.5
55	49.0	25.0	15	102.5	52.2	75	155.9	79.4	35	209.4	106.7	95	262.8	133.9
56	49.9	25.4	16	103.4	52.7	76	156.8	79.9	36	210.3	107.1	96	263.7	134.4
57	50.8	25.9	17	104.2	53.1	77	157.7	80.4	37	211.2	107.6	97	264.6	134.8
58	51.7	26.3	18	105.1	53.6	78	158.6	80.8	38	212.1	108.0	98	265.5	135.3
59	52.6	26.8	19	106.0	54.0	79	159.5	81.3	39	213.0	108.5	99	266.4	135.7
60	53.5	27.2	20	106.9	54.5	80	160.4	81.7	40	213.8	109.0	300	267.3	136.2
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 63 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.5	61	53.9	28.6	121	106.8	56.8	181	159.8	85.0	241	212.8	113.1
2	01.8	00.9	62	54.7	29.1	22	107.7	57.3	82	160.7	85.4	42	213.7	113.6
3	02.6	01.4	63	55.6	29.6	23	108.6	57.7	83	161.6	85.9	43	214.6	114.1
4	03.5	01.9	64	56.5	30.0	24	109.5	58.2	84	162.5	86.4	44	215.4	114.6
5	04.4	02.3	65	57.4	30.5	25	110.4	58.7	85	163.3	86.9	45	216.3	115.0
6	05.3	02.8	66	58.3	31.0	26	111.3	59.2	86	164.2	87.3	46	217.2	115.5
7	06.2	03.3	67	59.2	31.5	27	112.1	59.6	87	165.1	87.8	47	218.1	116.0
8	07.1	03.8	68	60.0	31.9	28	113.0	60.1	88	166.0	88.3	48	219.0	116.4
9	07.9	04.2	69	60.9	32.4	29	113.9	60.6	89	166.9	88.7	49	219.9	116.9
10	08.8	04.7	70	61.8	32.9	30	114.8	61.0	90	167.8	89.2	50	220.7	117.4
11	09.7	05.2	71	62.7	33.3	131	115.7	61.5	191	168.6	89.7	251	221.6	117.8
12	10.6	05.6	72	63.6	33.8	32	116.5	62.0	92	169.5	90.1	52	222.5	118.3
13	11.5	06.1	73	64.5	34.3	33	117.4	62.4	93	170.4	90.6	53	223.4	118.8
14	12.4	06.6	74	65.3	34.7	34	118.3	62.9	94	171.3	91.1	54	224.3	119.2
15	13.2	07.0	75	66.2	35.2	35	119.2	63.4	95	172.2	91.5	55	225.2	119.7
16	14.1	07.5	76	67.1	35.7	36	120.1	63.8	96	173.1	92.0	56	226.0	120.2
17	15.0	08.0	77	68.0	36.1	37	121.0	64.3	97	173.9	92.5	57	226.9	120.7
18	15.9	08.5	78	68.9	36.6	38	121.8	64.8	98	174.8	93.0	58	227.8	121.1
19	16.8	08.9	79	69.8	37.1	39	122.7	65.3	99	175.7	93.4	59	228.7	121.6
20	17.7	09.4	80	70.6	37.6	40	123.6	65.7	200	176.6	93.9	60	229.6	122.1
21	18.5	09.9	81	71.5	38.0	141	124.5	66.2	201	177.5	94.4	261	230.4	122.5
22	19.4	10.3	82	72.4	38.5	42	125.4	66.7	02	178.4	94.8	62	231.3	123.0
23	20.3	10.8	83	73.3	39.0	43	126.3	67.1	03	179.2	95.3	63	232.2	123.5
24	21.2	11.3	84	74.2	39.4	44	127.1	67.6	04	180.1	95.8	64	233.1	123.9
25	22.1	11.7	85	75.1	39.9	45	128.0	68.1	05	181.0	96.2	65	234.0	124.4
26	23.0	12.2	86	75.9	40.4	46	128.9	68.5	06	181.9	96.7	66	234.9	124.9
27	23.8	12.7	87	76.8	40.8	47	129.8	69.0	07	182.8	97.2	67	235.7	125.3
28	24.7	13.1	88	77.7	41.3	48	130.7	69.5	08	183.7	97.7	68	236.6	125.8
29	25.6	13.6	89	78.6	41.8	49	131.6	70.0	09	184.5	98.1	69	237.5	126.3
30	26.5	14.1	90	79.5	42.3	50	132.4	70.4	10	185.4	98.6	70	238.4	126.8
31	27.4	14.6	91	80.3	42.7	151	133.3	70.9	211	186.3	99.1	271	239.3	127.2
32	28.3	15.0	92	81.2	43.2	52	134.2	71.4	12	187.2	99.5	72	240.2	127.7
33	29.1	15.5	93	82.1	43.7	53	135.1	71.8	13	188.1	100.0	73	241.0	128.2
34	30.0	16.0	94	83.0	44.1	54	136.0	72.3	14	189.0	100.5	74	241.9	128.6
35	30.9	16.4	95	83.9	44.6	55	136.9	72.8	15	189.8	100.9	75	242.8	129.1
36	31.8	16.9	96	84.8	45.1	56	137.7	73.2	16	190.7	101.4	76	243.7	129.6
37	32.7	17.4	97	85.6	45.5	57	138.6	73.7	17	191.6	101.9	77	244.6	130.1
38	33.6	17.8	98	86.5	46.0	58	139.5	74.2	18	192.5	102.3	78	245.5	130.5
39	34.4	18.3	99	87.4	46.5	59	140.4	74.6	19	193.4	102.8	79	246.3	130.9
40	35.3	18.8	100	88.3	46.9	60	141.3	75.1	20	194.2	103.3	80	247.2	131.5
41	36.2	19.2	101	89.2	47.4	161	142.2	75.6	221	195.1	103.8	281	248.1	131.9
42	37.1	19.7	02	90.1	47.9	62	143.0	76.1	22	196.0	104.2	82	249.0	132.4
43	38.0	20.2	03	90.9	48.4	63	143.9	76.5	23	196.9	104.7	83	249.9	132.9
44	38.8	20.7	04	91.8	48.8	64	144.8	77.0	24	197.8	105.2	84	250.8	133.3
45	39.7	21.1	05	92.7	49.3	65	145.7	77.5	25	198.7	105.6	85	251.6	133.8
46	40.6	21.6	06	93.6	49.8	66	146.6	77.9	26	199.5	106.1	86	252.5	134.3
47	41.5	22.1	07	94.5	50.2	67	147.5	78.4	27	200.4	106.6	87	253.4	134.7
48	42.4	22.5	08	95.4	50.7	68	148.3	78.9	28	201.3	107.0	88	254.3	135.2
49	43.3	23.0	09	96.2	51.2	69	149.2	79.3	29	202.2	107.5	89	255.2	135.7
50	44.1	23.5	10	97.1	51.6	70	150.1	79.8	30	203.1	108.0	90	256.1	136.1
51	45.0	23.9	111	98.0	52.1	171	151.0	80.3	231	204.0	108.4	291	256.9	136.6
52	45.9	24.4	12	98.9	52.6	72	151.9	80.7	32	204.8	108.9	92	257.8	137.1
53	46.8	24.9	13	99.8	53.1	73	152.7	81.2	33	205.7	109.4	93	258.7	137.6
54	47.7	25.4	14	100.7	53.5	74	153.6	81.7	34	206.6	109.9	94	259.6	138.0
55	48.6	25.8	15	101.5	54.0	75	154.5	82.2	35	207.5	110.3	95	260.5	138.5
56	49.4	26.3	16	102.4	54.5	76	155.4	82.6	36	208.4	110.8	96	261.4	139.0
57	50.3	26.8	17	103.3	54.9	77	156.3	83.1	37	209.3	111.3	97	262.2	139.4
58	51.2	27.2	18	104.2	55.4	78	157.2	83.6	38	210.1	111.7	98	263.1	139.9
59	52.1	27.7	19	105.1	55.9	79	158.0	84.0	39	211.0	112.2	99	264.0	140.4
60	53.0	28.2	20	106.0	56.3	80	158.9	84.5	40	211.9	112.7	300	264.9	140.8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 62 Degrees.

Table II. Difference of Latitude and Departure for 29 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.5	61	53.4	29.6	121	105.8	58.7	181	158.3	87.8	241	210.8	116.8
2	01.7	01.0	62	54.2	30.1	22	106.7	59.1	82	159.2	88.2	42	211.7	117.3
3	02.6	01.5	63	55.1	30.5	23	107.6	59.6	83	160.1	88.7	43	212.5	117.8
4	03.5	01.9	64	56.0	31.0	24	108.5	60.1	84	160.9	89.2	44	213.4	118.3
5	04.4	02.4	65	56.8	31.5	25	109.3	60.6	85	161.8	89.7	45	214.3	118.8
6	05.2	02.9	66	57.7	32.0	26	110.2	61.1	86	162.7	90.2	46	215.2	119.3
7	06.1	03.4	67	58.6	32.5	27	111.1	61.6	87	163.6	90.7	47	216.0	119.7
8	07.0	03.9	68	59.5	33.0	28	112.0	62.1	88	164.4	91.1	48	216.9	120.2
9	07.9	04.4	69	60.3	33.5	29	112.8	62.5	89	165.3	91.6	49	217.8	120.7
10	08.7	04.8	70	61.2	33.9	30	113.7	63.0	90	166.2	92.1	50	218.7	121.2
11	09.6	05.3	71	62.1	34.4	131	114.6	63.5	191	167.1	92.6	251	219.5	121.7
12	10.5	05.8	72	63.0	34.9	32	115.4	64.0	92	167.9	93.1	52	220.4	122.2
13	11.4	06.3	73	63.8	35.4	33	116.3	64.5	93	168.8	93.6	53	221.3	122.7
14	12.2	06.8	74	64.7	35.9	34	117.2	65.0	94	169.7	94.1	54	222.2	123.1
15	13.1	07.3	75	65.6	36.4	35	118.1	65.4	95	170.6	94.5	55	223.0	123.6
16	14.0	07.8	76	66.5	36.8	36	118.9	65.9	96	171.4	95.0	56	223.9	124.1
17	14.9	08.2	77	67.3	37.3	37	119.8	66.4	97	172.3	95.5	57	224.8	124.6
18	15.7	08.7	78	68.2	37.8	38	120.7	66.9	98	173.2	96.0	58	225.7	125.1
19	16.6	09.2	79	69.1	38.3	39	121.6	67.4	99	174.0	96.5	59	226.5	125.6
20	17.5	09.7	80	70.0	38.8	40	122.4	67.9	200	174.9	97.0	60	227.4	126.1
21	18.4	10.2	81	70.8	39.3	141	123.3	68.4	201	175.8	97.4	261	228.3	126.5
22	19.2	10.7	82	71.7	39.8	42	124.2	68.8	02	176.7	97.9	62	229.2	127.0
23	20.1	11.2	83	72.6	40.2	43	125.1	69.3	03	177.5	98.4	63	230.0	127.5
24	21.0	11.6	84	73.5	40.7	44	125.9	69.8	04	178.4	98.9	64	230.9	128.0
25	21.9	12.1	85	74.3	41.2	45	126.8	70.3	05	179.3	99.4	65	231.8	128.5
26	22.7	12.6	86	75.2	41.7	46	127.7	70.8	06	180.2	99.9	66	232.6	129.0
27	23.6	13.1	87	76.1	42.2	47	128.6	71.3	07	181.0	100.4	67	233.5	129.4
28	24.5	13.6	88	77.0	42.7	48	129.4	71.8	08	181.9	100.8	68	234.4	129.9
29	25.4	14.1	89	77.8	43.1	49	130.3	72.2	09	182.8	101.3	69	235.3	130.4
30	26.2	14.5	90	78.7	43.6	50	131.2	72.7	10	183.7	101.8	70	236.1	130.9
31	27.1	15.0	91	79.6	44.1	151	132.1	73.2	211	184.5	102.3	271	237.0	131.4
32	28.0	15.5	92	80.5	44.6	52	132.9	73.7	12	185.4	102.8	72	237.9	131.9
33	28.9	16.0	93	81.3	45.1	53	133.8	74.2	13	186.3	103.3	73	238.8	132.4
34	29.7	16.5	94	82.2	45.6	54	134.7	74.7	14	187.2	103.7	74	239.6	132.8
35	30.6	17.0	95	83.1	46.1	55	135.6	75.1	15	188.0	104.2	75	240.5	133.3
36	31.5	17.5	96	84.0	46.5	56	136.4	75.6	16	188.9	104.7	76	241.4	133.8
37	32.4	17.9	97	84.8	47.0	57	137.3	76.1	17	189.8	105.2	77	242.3	134.3
38	33.2	18.4	98	85.7	47.5	58	138.2	76.6	18	190.7	105.7	78	243.1	134.8
39	34.1	18.9	99	86.6	48.0	59	139.1	77.1	19	191.5	106.2	79	244.0	135.3
40	35.0	19.4	100	87.5	48.5	60	139.9	77.6	20	192.4	106.7	80	244.9	135.7
41	35.9	19.9	101	88.3	49.0	161	140.8	78.1	221	193.3	107.1	281	245.8	136.2
42	36.7	20.4	02	89.2	49.5	62	141.7	78.5	22	194.2	107.6	82	246.6	136.7
43	37.6	20.8	03	90.1	49.9	63	142.6	79.0	23	195.0	108.1	83	247.5	137.2
44	38.5	21.3	04	91.0	50.4	64	143.4	79.5	24	195.9	108.6	84	248.4	137.7
45	39.4	21.8	05	91.8	50.9	65	144.3	80.0	25	196.8	109.1	85	249.3	138.2
46	40.2	22.3	06	92.7	51.4	66	145.2	80.5	26	197.7	109.6	86	250.1	138.7
47	41.1	22.8	07	93.6	51.9	67	146.1	81.0	27	198.5	110.1	87	251.0	139.1
48	42.0	23.3	08	94.5	52.4	68	146.9	81.4	28	199.4	110.5	88	251.9	139.6
49	42.9	23.8	09	95.3	52.8	69	147.8	81.9	29	200.3	111.0	89	252.8	140.1
50	43.7	24.2	10	96.2	53.3	70	148.7	82.4	30	201.2	111.5	90	253.6	140.6
51	44.6	24.7	111	97.1	53.8	171	149.6	82.9	231	202.0	112.0	291	254.5	141.1
52	45.5	25.2	12	98.0	54.3	72	150.4	83.4	32	202.9	112.5	92	255.4	141.6
53	46.4	25.7	13	98.8	54.8	73	151.3	83.9	33	203.8	113.0	93	256.3	142.0
54	47.2	26.2	14	99.7	55.3	74	152.2	84.4	34	204.7	113.4	94	257.1	142.5
55	48.1	26.7	15	100.6	55.8	75	153.1	84.8	35	205.5	113.9	95	258.0	143.0
56	49.0	27.1	16	101.5	56.2	76	153.9	85.3	36	206.4	114.4	96	258.9	143.5
57	49.9	27.6	17	102.3	56.7	77	154.8	85.8	37	207.3	114.9	97	259.8	144.0
58	50.7	28.1	18	103.2	57.2	78	155.7	86.3	38	208.2	115.4	98	260.6	144.5
59	51.6	28.6	19	104.1	57.7	79	156.6	86.8	39	209.0	115.9	99	261.5	145.0
60	52.5	29.1	20	105.0	58.2	80	157.4	87.3	40	209.9	116.4	100	262.4	145.4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep	Lat	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 61 Degrees.

Table II. Difference of Latitude and Departure for 32 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.5	61	51.7	32.3	121	102.6	64.1	181	153.5	95.9	241	204.4	127.7
2	01.7	01.1	62	52.6	32.9	22	103.5	64.7	82	154.3	96.4	42	205.2	128.2
3	02.5	01.6	63	53.4	33.4	23	104.3	65.2	83	155.2	97.0	43	206.1	128.8
4	03.4	02.1	64	54.3	33.9	24	105.2	65.7	84	156.0	97.5	44	206.9	129.3
5	04.2	02.6	65	55.1	34.4	25	106.0	66.2	85	156.9	98.0	45	207.8	129.8
6	05.1	03.2	66	56.0	35.0	26	106.9	66.8	86	157.7	98.6	46	208.6	130.4
7	05.9	03.7	67	56.8	35.5	27	107.7	67.3	87	158.6	99.1	47	209.5	130.9
8	06.8	04.2	68	57.7	36.0	28	108.6	67.8	88	159.4	99.6	48	210.3	131.4
9	07.6	04.8	69	58.5	36.6	29	109.4	68.4	89	160.3	100.2	49	211.2	131.9
10	08.5	05.3	70	59.4	37.1	30	110.2	68.9	90	161.1	100.7	50	212.0	132.5
11	09.3	05.8	71	60.2	37.6	131	111.1	69.4	191	162.0	101.2	251	212.8	133.0
12	10.2	06.4	72	61.1	38.2	32	111.9	69.9	92	162.8	101.7	52	213.7	133.5
13	11.0	06.9	73	61.9	38.7	33	112.8	70.5	93	163.7	102.3	53	214.6	134.1
14	11.9	07.4	74	62.8	39.2	34	113.6	71.0	94	164.5	102.8	54	215.4	134.6
15	12.7	07.9	75	63.6	39.8	35	114.5	71.5	95	165.4	103.3	55	216.3	135.1
16	13.6	08.5	76	64.5	40.3	36	115.3	72.1	96	166.2	103.9	56	217.1	135.7
17	14.4	09.0	77	65.3	40.8	37	116.2	72.6	97	167.1	104.4	57	217.9	136.2
18	15.3	09.5	78	66.1	41.3	38	117.0	73.1	98	167.9	104.9	58	218.8	136.7
19	16.1	10.1	79	67.0	41.9	39	117.9	73.7	99	168.8	105.5	59	219.6	137.2
20	17.0	10.6	80	67.8	42.4	40	118.8	74.2	200	169.6	106.0	60	220.5	137.8
21	17.8	11.1	81	68.7	42.9	141	119.6	74.7	201	170.5	106.5	261	221.3	138.3
22	18.7	11.7	82	69.5	43.5	42	120.4	75.2	02	171.3	107.0	62	222.2	138.8
23	19.5	12.2	83	70.4	44.0	43	121.3	75.8	03	172.2	107.6	63	223.0	139.4
24	20.4	12.7	84	71.2	44.5	44	122.1	76.3	04	173.0	108.1	64	223.9	139.9
25	21.2	13.2	85	72.1	45.0	45	123.0	76.8	05	173.8	108.6	65	224.7	140.4
26	22.0	13.8	86	72.9	45.6	46	123.8	77.4	06	174.7	109.2	66	225.6	141.0
27	22.9	14.3	87	73.8	46.1	47	124.7	77.9	07	175.5	109.7	67	226.4	141.5
28	23.7	14.8	88	74.6	46.6	48	125.5	78.4	08	176.4	110.2	68	227.3	142.0
29	24.6	15.4	89	75.5	47.2	49	126.4	79.0	09	177.2	110.8	69	228.1	142.5
30	25.4	15.9	90	76.3	47.7	50	127.2	79.5	10	178.1	111.3	70	229.0	143.1
31	26.3	16.4	91	77.2	48.2	151	128.1	80.0	211	178.9	111.8	271	229.8	143.6
32	27.1	17.0	92	78.0	48.8	52	128.9	80.5	12	179.8	112.3	72	230.7	144.1
33	28.0	17.5	93	78.9	49.3	53	129.8	81.1	13	180.6	112.9	73	231.5	144.7
34	28.8	18.0	94	79.7	49.8	54	130.6	81.6	14	181.5	113.4	74	232.4	145.2
35	29.7	18.5	95	80.6	50.3	55	131.4	82.1	15	182.3	113.9	75	233.2	145.7
36	30.5	19.1	96	81.4	50.9	56	132.3	82.7	16	183.2	114.5	76	234.1	146.3
37	31.4	19.6	97	82.3	51.4	57	133.1	83.2	17	184.0	115.0	77	234.9	146.8
38	32.2	20.1	98	83.1	51.9	58	134.0	83.7	18	184.9	115.5	78	235.8	147.3
39	33.1	20.7	99	84.0	52.5	59	134.8	84.2	19	185.7	116.1	79	236.6	147.8
40	33.9	21.2	100	84.8	53.0	60	135.7	84.8	20	186.6	116.6	80	237.5	148.4
41	34.8	21.7	101	85.7	53.5	161	136.5	85.3	221	187.4	117.1	281	238.3	148.9
42	35.6	22.3	02	86.5	54.1	62	137.4	85.8	22	188.3	117.6	82	239.1	149.4
43	36.5	22.8	03	87.3	54.6	63	138.2	86.4	23	189.1	118.2	83	240.0	150.0
44	37.3	23.3	04	88.2	55.1	64	139.1	86.9	24	190.0	118.7	84	240.8	150.5
45	38.2	23.8	05	89.0	55.6	65	139.9	87.4	25	190.8	119.2	85	241.7	151.0
46	39.0	24.4	06	89.9	56.2	66	140.8	88.0	26	191.6	119.8	86	242.5	151.6
47	39.9	24.9	07	90.7	56.7	67	141.6	88.5	27	192.5	120.3	87	243.4	152.1
48	40.7	25.4	08	91.6	57.2	68	142.5	89.0	28	193.4	120.8	88	244.2	152.6
49	41.6	26.0	09	92.4	57.8	69	143.3	89.6	29	194.2	121.4	89	245.1	153.1
50	42.4	26.5	10	93.3	58.3	70	144.2	90.1	30	195.1	121.9	90	245.9	153.7
51	43.3	27.0	111	94.1	58.8	171	145.0	90.6	231	195.9	122.4	291	246.8	154.2
52	44.1	27.6	12	95.0	59.4	72	145.9	91.1	32	196.7	122.9	92	247.6	154.7
53	44.9	28.1	13	95.8	59.9	73	146.7	91.7	33	197.6	123.5	93	248.5	155.3
54	45.8	28.6	14	96.7	60.4	74	147.6	92.2	34	198.4	124.0	94	249.3	155.8
55	46.6	29.1	15	97.5	60.9	75	148.4	92.8	35	199.3	124.5	95	250.2	156.3
56	47.5	29.7	16	98.4	61.5	76	149.3	93.3	36	200.1	125.1	96	251.0	156.9
57	48.3	30.2	17	99.2	62.0	77	150.1	93.8	37	201.0	125.6	97	251.9	157.4
58	49.2	30.7	18	100.1	62.5	78	151.0	94.3	38	201.8	126.1	98	252.7	157.9
59	50.0	31.3	19	100.9	63.1	79	151.8	94.9	39	202.7	126.7	99	253.6	158.4
60	50.9	31.8	20	101.8	63.6	80	152.6	95.4	40	203.5	127.2	300	254.4	159.0
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 58 Degrees.

TABLE II. Difference of Latitude and Departure for 31 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.5	61	52.3	31.4	121	103.7	62.3	181	155.1	93.2	241	206.6	124.1
2	01.7	01.0	62	53.1	31.9	22	104.6	62.8	82	156.0	93.7	42	207.4	124.6
3	02.6	01.5	63	54.0	32.4	23	105.4	63.3	83	156.9	94.3	43	208.3	125.2
4	03.4	02.1	64	54.9	33.0	24	106.3	63.9	84	157.7	94.8	44	209.1	125.7
5	04.3	02.6	65	55.7	33.5	25	107.1	64.4	85	158.6	95.3	45	210.0	126.2
6	05.1	03.1	66	56.6	34.0	26	108.0	64.9	86	159.4	95.8	46	210.9	126.7
7	06.0	03.6	67	57.4	34.5	27	108.9	65.4	87	160.3	96.3	47	211.7	127.2
8	06.9	04.1	68	58.3	35.0	28	109.7	65.9	88	161.1	96.8	48	212.6	127.7
9	07.7	04.6	69	59.1	35.5	29	110.6	66.4	89	162.0	97.3	49	213.4	128.2
10	08.6	05.2	70	60.0	36.1	30	111.4	67.0	90	162.9	97.9	50	214.3	128.8
11	09.4	05.7	71	60.9	36.6	131	112.3	67.5	191	163.7	98.4	251	215.1	129.3
12	10.3	06.2	72	61.7	37.1	32	113.1	68.0	92	164.6	98.9	52	216.0	129.8
13	11.1	06.7	73	62.6	37.6	33	114.0	68.5	93	165.4	99.4	53	216.9	130.3
14	12.0	07.2	74	63.4	38.1	34	114.9	69.0	94	166.3	99.9	54	217.7	130.8
15	12.9	07.7	75	64.3	38.6	35	115.7	69.5	95	167.1	100.4	55	218.6	131.3
16	13.7	08.2	76	65.1	39.1	36	116.6	70.0	96	168.0	100.9	56	219.4	131.8
17	14.6	08.8	77	66.0	39.7	37	117.4	70.6	97	168.9	101.5	57	220.2	132.4
18	15.4	09.3	78	66.9	40.2	38	118.3	71.1	98	169.7	102.0	58	221.1	132.9
19	16.3	09.8	79	67.7	40.7	39	119.1	71.6	99	170.6	102.5	59	222.0	133.4
20	17.1	10.3	80	68.6	41.2	40	120.0	72.1	200	171.4	103.0	60	222.9	133.9
21	18.0	10.8	81	69.4	41.7	141	120.9	72.6	201	172.3	103.5	261	223.7	134.4
22	18.9	11.3	82	70.3	42.2	42	121.7	73.1	02	173.1	104.0	62	224.6	134.9
23	19.7	11.8	83	71.1	42.7	43	122.6	73.7	03	174.0	104.6	63	225.4	135.5
24	20.6	12.4	84	72.0	43.3	44	123.4	74.2	04	174.9	105.1	64	226.3	136.0
25	21.4	12.9	85	72.9	43.8	45	124.3	74.7	05	175.7	105.6	65	227.1	136.5
26	22.3	13.4	86	73.7	44.3	46	125.1	75.2	06	176.6	106.1	66	228.0	137.0
27	23.1	13.9	87	74.6	44.8	47	126.0	75.7	07	177.4	106.6	67	228.9	137.5
28	24.0	14.4	88	75.4	45.3	48	126.9	76.2	08	178.3	107.1	68	229.7	138.0
29	24.9	14.9	89	76.3	45.8	49	127.7	76.7	09	179.1	107.6	69	230.6	138.5
30	25.7	15.5	90	77.1	46.4	50	128.6	77.3	10	180.0	108.2	70	231.4	139.1
31	26.6	16.0	91	78.0	46.9	151	129.4	77.8	211	180.9	108.7	271	232.2	139.6
32	27.4	16.5	92	78.9	47.4	52	130.3	78.3	12	181.7	109.2	72	233.1	140.1
33	28.3	17.0	93	79.7	47.9	53	131.1	78.8	13	182.6	109.7	73	234.0	140.6
34	29.1	17.5	94	80.6	48.4	54	132.0	79.3	14	183.4	110.2	74	234.9	141.1
35	30.0	18.0	95	81.4	48.9	55	132.9	79.8	15	184.3	110.7	75	235.7	141.6
36	30.9	18.5	96	82.3	49.4	56	133.7	80.3	16	185.1	111.2	76	236.6	142.2
37	31.7	19.1	97	83.1	50.0	57	134.6	80.9	17	186.0	111.8	77	237.4	142.7
38	32.6	19.6	98	84.0	50.5	58	135.4	81.4	18	186.9	112.3	78	238.3	143.2
39	33.4	20.1	99	84.9	51.0	59	136.3	81.9	19	187.7	112.8	79	239.1	143.7
40	34.3	20.6	100	85.7	51.5	60	137.1	82.4	20	188.6	113.3	80	240.0	144.2
41	35.1	21.1	101	86.6	52.0	161	138.0	82.9	221	189.4	113.8	281	240.9	144.7
42	36.0	21.6	02	87.4	52.5	62	138.9	83.4	22	190.3	114.3	82	241.7	145.2
43	36.9	22.1	03	88.3	53.0	63	139.7	84.0	23	191.1	114.9	83	242.6	145.8
44	37.7	22.7	04	89.1	53.6	64	140.6	84.5	24	192.0	115.4	84	243.4	146.3
45	38.6	23.2	05	90.0	54.1	65	141.4	85.0	25	192.9	115.9	85	244.3	146.8
46	39.4	23.7	06	90.9	54.6	66	142.3	85.5	26	193.7	116.4	86	245.1	147.3
47	40.3	24.2	07	91.7	55.1	67	143.1	86.0	27	194.6	116.9	87	246.0	147.8
48	41.1	24.7	08	92.6	55.6	68	144.0	86.5	28	195.4	117.4	88	246.9	148.3
49	42.0	25.2	09	93.4	56.1	69	144.9	87.0	29	196.3	117.9	89	247.7	148.8
50	42.9	25.8	10	94.3	56.7	70	145.7	87.6	30	197.1	118.5	90	248.6	149.4
51	43.7	26.3	111	95.1	57.2	171	146.6	88.1	231	198.0	119.0	291	249.4	149.9
52	44.6	26.8	12	96.0	57.7	72	147.4	88.6	32	198.9	119.5	92	250.3	150.4
53	45.4	27.3	13	96.9	58.2	73	148.3	89.1	33	199.7	120.0	93	251.2	150.9
54	46.3	27.8	14	97.7	58.7	74	149.1	89.6	34	200.6	120.5	94	252.0	151.4
55	47.1	28.3	15	98.6	59.2	75	150.0	90.1	35	201.4	121.0	95	252.9	151.9
56	48.0	28.8	16	99.4	59.7	76	150.9	90.6	36	202.3	121.5	96	253.7	152.5
57	48.9	29.4	17	100.3	60.3	77	151.7	91.2	37	203.1	122.1	97	254.6	153.0
58	49.7	29.9	18	101.1	60.8	78	152.6	91.7	38	204.0	122.6	98	255.4	153.5
59	50.6	30.4	19	102.0	61.3	79	153.4	92.2	39	204.9	123.1	99	256.3	154.0
60	51.4	30.9	20	102.9	61.8	80	154.3	92.7	40	205.7	123.6	300	257.1	154.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 59 Degrees.

TABLE II. Difference of Latitude and Departure for 34 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	50.6	34.1	121	100.3	67.7	181	150.1	101.2	241	199.8	134.8
2	01.7	01.1	62	51.4	34.7	22	101.1	68.2	82	150.9	101.8	42	200.6	135.3
3	02.5	01.7	63	52.2	35.2	23	102.0	68.8	83	151.7	102.3	43	201.5	135.9
4	03.3	02.2	64	53.1	35.8	24	102.8	69.3	84	152.5	102.9	44	202.3	136.4
5	04.1	02.8	65	53.9	36.3	25	103.6	69.9	85	153.4	103.5	45	203.1	137.0
6	05.0	03.4	66	54.7	36.9	26	104.5	70.5	86	154.2	104.0	46	203.9	137.6
7	05.8	03.9	67	55.5	37.5	27	105.3	71.0	87	155.0	104.6	47	204.8	138.1
8	06.6	04.5	68	56.4	38.0	28	106.1	71.6	88	155.9	105.1	48	205.6	138.7
9	07.5	05.0	69	57.2	38.6	29	106.9	72.1	89	156.7	105.7	49	206.4	139.2
10	08.3	05.6	70	58.0	39.1	30	107.8	72.7	90	157.5	106.2	50	207.3	139.8
11	09.1	06.2	71	58.9	39.7	131	108.6	73.3	191	158.3	106.8	251	208.1	140.4
12	09.9	06.7	72	59.7	40.3	32	109.4	73.8	92	159.2	107.4	52	208.9	140.9
13	10.8	07.3	73	60.5	40.8	33	110.3	74.4	93	160.0	107.9	53	209.7	141.5
14	11.6	07.8	74	61.3	41.4	34	111.1	74.9	94	160.8	108.5	54	210.6	142.0
15	12.4	08.4	75	62.2	41.9	35	111.9	75.5	95	161.7	109.0	55	211.4	142.6
16	13.3	08.9	76	63.0	42.5	36	112.7	76.1	96	162.5	109.6	56	212.2	143.2
17	14.1	09.5	77	63.8	43.1	37	113.6	76.6	97	163.3	110.2	57	213.1	143.7
18	14.9	10.1	78	64.7	43.6	38	114.4	77.2	98	164.1	110.7	58	213.9	144.3
19	15.8	10.6	79	65.5	44.2	39	115.2	77.7	99	165.0	111.3	59	214.7	144.8
20	16.6	11.2	80	66.3	44.7	40	116.1	78.3	200	165.8	111.8	60	215.5	145.4
21	17.4	11.7	81	67.1	45.3	141	116.9	78.8	201	166.6	112.4	261	216.4	145.9
22	18.2	12.3	82	68.0	45.9	42	117.7	79.4	02	167.5	113.0	62	217.2	146.5
23	19.1	12.9	83	68.8	46.4	43	118.6	80.0	03	168.3	113.5	63	218.0	147.1
24	19.9	13.4	84	69.6	47.0	44	119.4	80.5	04	169.1	114.1	64	218.9	147.6
25	20.7	14.0	85	70.5	47.5	45	120.2	81.1	05	170.0	114.6	65	219.7	148.2
26	21.6	14.5	86	71.3	48.1	46	121.0	81.6	06	170.8	115.2	66	220.5	148.7
27	22.4	15.1	87	72.1	48.6	47	121.9	82.2	07	171.6	115.8	67	221.4	149.3
28	23.2	15.7	88	73.0	49.2	48	122.7	82.8	08	172.4	116.3	68	222.2	149.9
29	24.0	16.2	89	73.8	49.8	49	123.5	83.3	09	173.3	116.9	69	223.0	150.4
30	24.9	16.8	90	74.6	50.3	50	124.4	83.9	10	174.1	117.4	70	223.8	151.0
31	25.7	17.3	91	75.4	50.9	151	125.2	84.4	211	174.9	118.0	271	224.7	151.5
32	26.5	17.9	92	76.3	51.4	52	126.0	85.0	12	175.8	118.5	72	225.5	152.1
33	27.4	18.5	93	77.1	52.0	53	126.8	85.6	13	176.6	119.1	73	226.3	152.7
34	28.2	19.0	94	77.9	52.6	54	127.7	86.1	14	177.4	119.7	74	227.2	153.2
35	29.0	19.6	95	78.8	53.1	55	128.5	86.7	15	178.2	120.2	75	228.0	153.8
36	29.8	20.1	96	79.6	53.7	56	129.3	87.2	16	179.1	120.8	76	228.8	154.3
37	30.7	20.7	97	80.4	54.2	57	130.2	87.8	17	179.9	121.3	77	229.6	154.9
38	31.5	21.2	98	81.2	54.8	58	131.0	88.4	18	180.7	121.9	78	230.5	155.5
39	32.3	21.8	99	82.1	55.4	59	131.8	88.9	19	181.6	122.5	79	231.3	156.0
40	33.2	22.4	100	82.9	55.9	60	132.6	89.5	20	182.4	123.0	80	232.1	156.6
41	34.0	22.9	101	83.7	56.5	161	133.5	90.0	221	183.2	123.6	281	233.0	157.1
42	34.8	23.5	02	84.6	57.0	62	134.3	90.6	22	184.0	124.1	82	233.8	157.7
43	35.6	24.0	03	85.4	57.6	63	135.1	91.1	23	184.9	124.7	83	234.6	158.3
44	36.5	24.6	04	86.2	58.2	64	136.0	91.7	24	185.7	125.3	84	235.4	158.8
45	37.3	25.2	05	87.0	58.7	65	136.8	92.3	25	186.5	125.8	85	236.3	159.4
46	38.1	25.7	06	87.9	59.3	66	137.6	92.8	26	187.4	126.4	86	237.1	159.9
47	39.0	26.3	07	88.7	59.8	67	138.4	93.4	27	188.2	126.9	87	237.9	160.5
48	39.8	26.8	08	89.5	60.4	68	139.3	93.9	28	189.0	127.5	88	238.8	161.0
49	40.6	27.4	09	90.4	61.0	69	140.1	94.5	29	189.8	128.1	89	239.6	161.6
50	41.5	28.0	10	91.2	61.5	70	140.9	95.1	30	190.7	128.6	90	240.4	162.2
51	42.3	28.5	111	92.0	62.1	171	141.8	95.6	231	191.5	129.2	291	241.2	162.7
52	43.1	29.1	12	92.9	62.6	72	142.6	96.2	32	192.3	129.7	92	242.1	163.3
53	43.9	29.6	13	93.7	63.2	73	143.4	96.7	33	193.2	130.3	93	242.9	163.8
54	44.8	30.2	14	94.5	63.7	74	144.3	97.3	34	194.0	130.9	94	243.7	164.4
55	45.6	30.8	15	95.3	64.3	75	145.1	97.9	35	194.8	131.4	95	244.6	165.0
56	46.4	31.3	16	96.2	64.9	76	145.9	98.4	36	195.7	132.0	96	245.4	165.6
57	47.3	31.9	17	97.0	65.4	77	146.7	99.0	37	196.5	132.5	97	246.2	166.1
58	48.1	32.4	18	97.8	66.0	78	147.6	99.5	38	197.3	133.1	98	247.1	166.6
59	48.9	33.0	19	98.7	66.5	79	148.4	100.1	39	198.1	133.6	99	247.9	167.2
60	49.7	33.6	20	99.5	67.1	80	149.2	100.7	40	199.0	134.2	300	248.7	167.8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 56 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	50.0	35.0	121	99.1	69.4	151	148.3	103.8	241	197.4	138.2
2	01.6	01.1	62	50.8	35.6	22	99.9	70.0	82	149.1	104.4	42	198.2	138.8
3	02.5	01.7	63	51.6	36.1	23	100.8	70.5	83	149.9	105.0	43	199.1	139.4
4	03.3	02.3	64	52.4	36.7	24	101.6	71.1	84	150.7	105.5	44	199.9	140.0
5	04.1	02.9	65	53.2	37.3	25	102.4	71.7	85	151.5	106.1	45	200.7	140.5
6	04.9	03.4	66	54.1	37.9	26	103.2	72.3	86	152.4	106.7	46	201.5	141.1
7	05.7	04.0	67	54.9	38.4	27	104.0	72.8	87	153.2	107.3	47	202.3	141.7
8	06.6	04.6	68	55.7	39.0	28	104.9	73.4	88	154.0	107.8	48	203.1	142.2
9	07.4	05.2	69	56.5	39.6	29	105.7	74.0	89	154.8	108.4	49	204.0	142.8
10	08.2	05.7	70	57.3	40.2	30	106.5	74.6	90	155.6	109.0	50	204.8	143.4
11	09.0	06.3	71	58.2	40.7	131	107.3	75.1	191	156.5	109.5	251	205.6	144.0
12	09.8	06.9	72	59.0	41.3	32	108.1	75.7	92	157.3	110.1	52	206.4	144.5
13	10.6	07.5	73	59.8	41.9	33	108.9	76.3	93	158.1	110.7	53	207.2	145.1
14	11.5	08.0	74	60.6	42.4	34	109.8	76.9	94	158.9	111.3	54	208.1	145.7
15	12.3	08.6	75	61.4	43.0	35	110.6	77.4	95	159.7	111.8	55	208.9	146.3
16	13.1	09.2	76	62.2	43.6	36	111.4	78.0	96	160.6	112.4	56	209.7	146.8
17	13.9	09.8	77	63.1	44.2	37	112.2	78.6	97	161.4	113.0	57	210.5	147.4
18	14.7	10.3	78	63.9	44.7	38	113.0	79.2	98	162.2	113.6	58	211.3	148.0
19	15.6	10.9	79	64.7	45.3	39	113.8	79.7	99	163.0	114.1	59	212.2	148.5
20	16.4	11.5	80	65.5	45.9	40	114.7	80.3	200	163.8	114.7	60	213.0	149.1
21	17.2	12.0	81	66.4	46.5	141	115.5	80.9	201	164.6	115.3	261	213.8	149.7
22	18.0	12.6	82	67.2	47.0	42	116.3	81.4	02	165.5	115.9	62	214.6	150.3
23	18.8	13.2	83	68.0	47.6	43	117.1	82.0	03	166.3	116.4	63	215.4	150.9
24	19.7	13.8	84	68.8	48.2	44	118.0	82.6	04	167.1	117.0	64	216.3	151.4
25	20.5	14.3	85	69.6	48.8	45	118.8	83.2	05	167.9	117.6	65	217.1	152.0
26	21.3	14.9	86	70.4	49.3	46	119.6	83.7	06	168.7	118.2	66	217.9	152.6
27	22.1	15.5	87	71.3	49.9	47	120.4	84.3	07	169.6	118.7	67	218.7	153.1
28	22.9	16.1	88	72.1	50.5	48	121.2	84.9	08	170.4	119.3	68	219.5	153.7
29	23.8	16.6	89	72.9	51.0	49	122.1	85.5	09	171.2	119.9	69	220.4	154.3
30	24.6	17.2	90	73.7	51.6	50	122.9	86.0	10	172.0	120.5	70	221.2	154.9
31	25.4	17.8	91	74.5	52.2	151	123.7	86.6	211	172.8	121.0	271	221.0	155.4
32	26.2	18.4	92	75.4	52.8	52	124.5	87.2	12	173.7	121.6	72	222.8	156.0
33	27.0	18.9	93	76.2	53.3	53	125.3	87.8	13	174.5	122.2	73	223.6	156.6
34	27.9	19.5	94	77.0	53.9	54	126.1	88.3	14	175.3	122.7	74	224.4	157.2
35	28.7	20.1	95	77.8	54.5	55	127.0	88.9	15	176.1	123.3	75	225.3	157.7
36	29.5	20.6	96	78.6	55.1	56	127.8	89.5	16	176.9	123.9	76	226.1	158.3
37	30.3	21.2	97	79.5	55.6	57	128.6	90.1	17	177.8	124.5	77	226.9	158.9
38	31.1	21.8	98	80.3	56.2	58	129.4	90.6	18	178.6	125.0	78	227.7	159.5
39	31.9	22.4	99	81.1	56.8	59	130.2	91.2	19	179.4	125.6	79	228.5	160.0
40	32.8	22.9	100	81.9	57.4	60	131.1	91.8	20	180.2	126.2	80	229.4	160.6
41	33.6	23.5	101	82.7	57.9	161	131.9	92.3	221	181.0	126.8	281	230.2	161.2
42	34.4	24.1	02	83.6	58.5	62	132.7	92.9	22	181.9	127.3	82	231.0	161.7
43	35.2	24.7	03	84.4	59.1	63	133.5	93.5	23	182.7	127.9	83	231.8	162.3
44	36.0	25.2	04	85.2	59.7	64	134.3	94.1	24	183.5	128.5	84	232.6	162.9
45	36.9	25.8	05	86.0	60.2	65	135.2	94.6	25	184.3	129.1	85	233.5	163.5
46	37.7	26.4	06	86.8	60.8	66	136.0	95.2	26	185.1	129.6	86	234.3	164.0
47	38.5	27.0	07	87.6	61.4	67	136.8	95.8	27	185.9	130.2	87	235.1	164.6
48	39.3	27.5	08	88.5	61.9	68	137.6	96.4	28	186.8	130.8	88	235.[illegible]	165.2
49	40.1	28.1	09	89.3	62.5	69	138.4	96.9	29	187.6	131.3	89	236.7	165.8
50	41.0	28.7	10	90.1	63.1	70	139.3	97.5	30	188.4	131.9	90	237.6	166.3
51	41.8	29.2	111	90.9	63.7	171	140.1	98.1	231	189.2	132.5	291	238.4	166.9
52	42.6	29.8	12	91.7	64.2	72	140.9	98.7	32	190.0	133.1	92	239.2	167.5
53	43.4	30.4	13	92.6	64.8	73	141.7	99.2	33	190.9	133.6	93	240.0	168.9
54	44.2	31.0	14	93.4	65.4	74	142.5	99.8	34	191.7	134.2	94	240.8	165.6
55	45.1	31.5	15	94.2	66.0	75	143.4	100.4	35	192.5	134.8	95	241.6	169.2
56	45.9	32.1	16	95.0	66.5	76	144.2	100.9	36	193.3	135.4	96	242.5	169.8
57	46.7	32.7	17	95.8	67.1	77	145.0	101.5	37	194.1	135.9	97	243.3	170.4
58	47.5	33.3	18	96.7	67.7	78	145.8	102.1	38	195.0	136.5	98	244.1	170.9
59	48.3	33.8	19	97.5	68.3	79	146.6	102.7	39	195.8	137.1	99	244.9	171.5
60	49.1	34.4	20	98.3	68.8	80	147.4	103.2	40	196.6	137.7	300	245.7	172.1
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 55 Degrees.

Table II. Difference of Latitude and Departure for 36 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	49.4	35.9	121	97.9	71.1	181	146.4	106.4	241	195.0	141.7
2	01.6	01.2	62	50.2	36.4	22	98.7	71.7	82	147.2	107.0	42	195.8	142.2
3	02.4	01.8	63	51.0	37.0	23	99.5	72.3	83	148.1	107.6	43	196.6	142.8
4	03.2	02.4	64	51.8	37.6	24	100.3	72.9	84	148.9	108.2	44	197.4	143.4
5	04.0	02.9	65	52.6	38.2	25	101.1	73.5	85	149.7	108.7	45	198.2	144.0
6	04.9	03.5	66	53.4	38.8	26	101.9	74.1	86	150.5	109.3	46	199.0	144.6
7	05.7	04.1	67	54.2	39.4	27	102.7	74.6	87	151.3	109.9	47	199.8	145.2
8	06.5	04.7	68	55.0	40.0	28	103.6	75.2	88	152.1	110.5	48	200.6	145.8
9	07.3	05.3	69	55.8	40.6	29	104.4	75.8	89	152.9	111.1	49	201.4	146.4
10	08.1	05.9	70	56.6	41.1	30	105.2	76.4	90	153.7	111.7	50	202.3	146.9
11	08.9	06.5	71	57.4	41.7	131	106.0	77.0	191	154.5	112.3	251	203.1	147.5
12	09.7	07.1	72	58.2	42.3	32	106.8	77.6	92	155.3	112.9	52	203.9	148.1
13	10.5	07.6	73	59.1	42.9	33	107.6	78.2	93	156.1	113.4	53	204.7	148.7
14	11.3	08.2	74	59.9	43.5	34	108.4	78.8	94	156.9	114.0	54	205.5	149.3
15	12.1	08.8	75	60.7	44.1	35	109.2	79.4	95	157.8	114.6	55	206.3	149.9
16	12.9	09.4	76	61.5	44.7	36	110.0	79.9	96	158.6	115.2	56	207.1	150.5
17	13.8	10.0	77	62.3	45.3	37	110.8	80.5	97	159.4	115.8	57	207.9	151.1
18	14.6	10.6	78	63.1	45.8	38	111.6	81.1	98	160.2	116.4	58	208.7	151.6
19	15.4	11.2	79	63.9	46.4	39	112.5	81.7	99	161.0	117.0	59	209.5	152.2
20	16.2	11.8	80	64.7	47.0	40	113.3	82.3	200	161.8	117.6	60	210.3	152.8
21	17.0	12.3	81	65.5	47.6	141	114.1	82.9	201	162.6	118.1	261	211.2	153.4
22	17.8	12.9	82	66.3	48.2	42	114.9	83.5	02	163.4	118.7	62	212.0	154.0
23	18.6	13.5	83	67.1	48.8	43	115.7	84.1	03	164.2	119.3	63	212.8	154.6
24	19.4	14.1	84	68.0	49.4	44	116.5	84.6	04	165.0	119.9	64	213.6	155.2
25	20.2	14.7	85	68.8	50.0	45	117.3	85.2	05	165.8	120.5	65	214.4	155.8
26	21.0	15.3	86	69.6	50.5	46	118.1	85.8	06	166.7	121.1	66	215.2	156.4
27	21.8	15.9	87	70.4	51.1	47	118.9	86.4	07	167.5	121.7	67	216.0	156.9
28	22.7	16.5	88	71.2	51.7	48	119.7	87.0	08	168.3	122.3	68	216.8	157.5
29	23.5	17.0	89	72.0	52.3	49	120.5	87.6	09	169.1	122.8	69	217.6	158.1
30	24.3	17.6	90	72.8	52.9	50	121.4	88.2	10	169.9	123.4	70	218.4	158.7
31	25.1	18.2	91	73.6	53.5	151	122.2	88.8	211	170.7	124.0	271	219.2	159.3
32	25.9	18.8	92	74.4	54.1	52	123.0	89.3	12	171.5	124.6	72	220.1	159.9
33	26.7	19.4	93	75.2	54.7	53	123.8	89.9	13	172.3	125.2	73	220.9	160.5
34	27.5	20.0	94	76.0	55.3	54	124.6	90.5	14	173.1	125.8	74	221.7	161.1
35	28.3	20.6	95	76.9	55.5	55	125.4	91.1	15	173.9	126.4	75	222.5	161.6
36	29.1	21.2	96	77.7	56.4	56	126.2	91.7	16	174.7	127.0	76	223.3	162.2
37	29.9	21.7	97	78.5	57.0	57	127.0	92.3	17	175.6	127.5	77	224.1	162.8
38	30.7	22.3	98	79.3	57.6	58	127.8	92.9	18	176.4	128.1	78	224.9	163.4
39	31.6	22.9	99	80.1	58.2	59	128.6	93.5	19	177.2	128.7	79	225.7	164.0
40	32.4	23.5	100	80.9	58.8	60	129.4	94.0	20	178.0	129.3	80	226.5	164.6
41	33.2	24.1	101	81.7	59.4	161	130.3	94.6	221	178.8	129.9	281	227.3	165.2
42	34.0	24.7	02	82.5	60.0	62	131.1	95.2	22	179.6	130.5	82	228.1	165.8
43	34.8	25.3	03	83.3	60.5	63	131.9	95.8	23	180.4	131.1	83	229.0	166.3
44	35.6	25.9	04	84.1	61.1	64	132.7	96.4	24	181.2	131.7	84	229.8	166.9
45	36.4	26.5	05	84.9	61.7	65	133.5	97.0	25	182.0	132.3	85	230.6	167.5
46	37.2	27.0	06	85.8	62.3	66	134.3	97.6	26	182.8	132.8	86	231.4	168.1
47	38.0	27.6	07	86.6	62.9	67	135.1	98.2	27	183.6	133.4	87	232.2	168.7
48	38.8	28.2	08	87.4	63.5	68	135.9	98.7	28	184.5	134.0	88	233.0	169.3
49	39.6	28.8	09	88.2	64.1	69	136.7	99.3	29	185.3	134.6	89	233.8	169.9
50	40.5	29.4	10	89.0	64.7	70	137.5	99.9	30	186.1	135.2	90	234.6	170.5
51	41.3	30.0	111	89.8	65.2	171	138.3	100.5	231	186.9	135.8	291	235.4	171.0
52	42.1	30.6	12	90.6	65.8	72	139.2	101.1	32	187.7	136.4	92	236.2	171.6
53	42.9	31.2	13	91.4	66.4	73	140.0	101.7	33	188.5	137.0	93	237.0	172.2
54	43.7	31.7	14	92.2	67.0	74	140.8	102.3	34	189.3	137.5	94	237.9	172.8
55	44.5	32.3	15	93.0	67.6	75	141.6	102.9	35	190.1	138.1	95	238.7	173.4
56	45.3	32.9	16	93.8	68.2	76	142.4	103.5	36	190.9	138.7	96	239.5	174.0
57	46.1	33.5	17	94.7	68.8	77	143.2	104.0	37	191.7	139.3	97	240.3	174.6
58	46.9	34.1	18	95.5	69.4	78	144.0	104.6	38	192.5	139.9	98	241.1	175.2
59	47.7	34.7	19	96.3	69.9	79	144.8	105.2	39	193.4	140.5	99	241.9	175.7
60	48.5	35.3	20	97.1	70.5	80	145.6	105.8	40	194.2	141.1	300	242.7	176.3
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 54 Degrees.

Table II. Difference of Latitude and Departure for 35 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	50.0	35.0	121	99.1	69.4	181	148.3	103.8	241	197.4	138.2
2	01.6	01.1	62	50.8	35.6	22	99.9	70.0	82	149.1	104.4	42	198.2	138.8
3	02.5	01.7	63	51.6	36.1	23	100.8	70.5	83	149.9	105.0	43	199.1	139.4
4	03.3	02.3	64	52.4	36.7	24	101.6	71.1	84	150.7	105.5	44	199.9	140.0
5	04.1	02.9	65	53.2	37.3	25	102.4	71.7	85	151.5	106.1	45	200.7	140.5
6	04.9	03.4	66	54.1	37.9	26	103.2	72.3	86	152.4	106.7	46	201.5	141.1
7	05.7	04.0	67	54.9	38.4	27	104.0	72.8	87	153.2	107.3	47	202.3	141.7
8	06.6	04.6	68	55.7	39.0	28	104.9	73.4	88	154.0	107.8	48	203.1	142.2
9	07.4	05.2	69	56.5	39.6	29	105.7	74.0	89	154.8	108.4	49	204.0	142.8
10	08.2	05.7	70	57.3	40.2	30	106.5	74.6	90	155.6	109.0	50	204.8	143.4
11	09.0	06.3	71	58.2	40.7	131	107.3	75.1	191	156.5	109.5	251	205.6	144.0
12	09.8	06.9	72	59.0	41.3	32	108.1	75.7	92	157.3	110.1	52	206.4	144.5
13	10.6	07.5	73	59.8	41.9	33	108.9	76.3	93	158.1	110.7	53	207.2	145.1
14	11.5	08.0	74	60.6	42.4	34	109.8	76.9	94	158.9	111.3	54	208.1	145.7
15	12.3	08.6	75	61.4	43.0	35	110.6	77.4	95	159.7	111.8	55	208.9	146.3
16	13.1	09.2	76	62.2	43.6	36	111.4	78.0	96	160.6	112.4	56	209.7	146.8
17	13.9	09.8	77	63.1	44.2	37	112.2	78.6	97	161.4	113.0	57	210.5	147.4
18	14.7	10.3	78	63.9	44.7	38	113.0	79.2	98	162.2	113.6	58	211.3	148.0
19	15.6	10.9	79	64.7	45.3	39	113.8	79.7	99	163.0	114.1	59	212.2	148.5
20	16.4	11.5	80	65.5	45.9	40	114.7	80.3	200	163.8	114.7	60	213.0	149.1
21	17.2	12.0	81	66.4	46.5	141	115.5	80.9	201	164.6	115.3	261	213.8	149.7
22	18.0	12.6	82	67.2	47.0	42	116.3	81.4	02	165.5	115.9	62	214.6	150.3
23	18.8	13.2	83	68.0	47.6	43	117.1	82.0	03	166.3	116.4	63	215.4	150.9
24	19.7	13.8	84	68.8	48.2	44	118.0	82.6	04	167.1	117.0	64	216.3	151.4
25	20.5	14.3	85	69.6	48.8	45	118.8	83.2	05	167.9	117.6	65	217.1	152.0
26	21.3	14.9	86	70.4	49.3	46	119.6	83.7	06	168.7	118.2	66	217.9	152.6
27	22.1	15.5	87	71.3	49.9	47	120.4	84.3	07	169.6	118.7	67	218.7	153.1
28	22.9	16.1	88	72.1	50.5	48	121.2	84.9	08	170.4	119.3	68	219.5	153.7
29	23.8	16.6	89	72.9	51.0	49	122.1	85.5	09	171.2	119.9	69	220.4	154.3
30	24.6	17.2	90	73.7	51.6	50	122.9	86.0	10	172.0	120.5	70	221.2	154.9
31	25.4	17.8	91	74.5	52.2	151	123.7	86.6	211	172.8	121.0	271	221.0	155.4
32	26.2	18.4	92	75.4	52.8	52	124.5	87.2	12	173.7	121.6	72	222.8	156.0
33	27.0	18.9	93	76.2	53.3	53	125.3	87.8	13	174.5	122.2	73	223.6	156.6
34	27.9	19.5	94	77.0	53.9	54	126.1	88.3	14	175.3	122.7	74	224.4	157.2
35	28.7	20.1	95	77.8	54.5	55	127.0	88.9	15	176.1	123.3	75	225.3	157.7
36	29.5	20.6	96	78.6	55.1	56	127.8	89.5	16	176.9	123.9	76	226.1	158.3
37	30.3	21.2	97	79.5	55.6	57	128.6	90.1	17	177.8	124.5	77	226.9	158.9
38	31.1	21.8	98	80.3	56.2	58	129.4	90.6	18	178.6	125.0	78	227.7	159.5
39	31.9	22.4	99	81.1	56.8	59	130.2	91.2	19	179.4	125.6	79	228.5	160.0
40	32.8	22.9	100	81.9	57.4	60	131.1	91.8	20	180.2	126.2	80	229.4	160.6
41	33.6	23.5	101	82.7	57.9	161	131.9	92.3	221	181.0	126.8	281	230.2	161.2
42	34.4	24.1	02	83.6	58.5	62	132.7	92.9	22	181.9	127.3	82	231.0	161.7
43	35.2	24.7	03	84.4	59.1	63	133.5	93.5	23	182.7	127.9	83	231.8	162.3
44	36.0	25.2	04	85.2	59.7	64	134.3	94.1	24	183.5	128.5	84	232.6	162.9
45	36.9	25.8	05	86.0	60.2	65	135.2	94.6	25	184.3	129.1	85	233.5	163.5
46	37.7	26.4	06	86.8	60.8	66	136.0	95.2	26	185.1	129.6	86	234.3	164.0
47	38.5	27.0	07	87.6	61.4	67	136.8	95.8	27	185.9	130.2	87	235.1	164.6
48	39.3	27.5	08	88.5	61.9	68	137.6	96.4	28	186.8	130.8	88	235.9	165.2
49	40.1	28.1	09	89.3	62.5	69	138.4	96.9	29	187.6	131.3	89	236.7	165.8
50	41.0	28.7	10	90.1	63.1	70	139.3	97.5	30	188.4	131.9	90	237.6	166.3
51	41.8	29.2	111	90.9	63.7	171	140.1	98.1	231	189.2	132.5	291	238.4	166.9
52	42.6	29.8	12	91.7	64.2	72	140.9	98.7	32	190.0	133.1	92	239.2	167.5
53	43.4	30.4	13	92.6	64.8	73	141.7	99.2	33	190.9	133.6	93	240.0	168.1
54	44.2	31.0	14	93.4	65.4	74	142.5	99.8	34	191.7	134.2	94	240.8	168.6
55	45.1	31.5	15	94.2	66.0	75	143.4	100.4	35	192.5	134.8	95	241.6	169.2
56	45.9	32.1	16	95.0	66.5	76	144.2	100.9	36	193.3	135.4	96	242.5	169.8
57	46.7	32.7	17	95.8	67.1	77	145.0	101.5	37	194.1	135.9	97	243.3	170.4
58	47.5	33.3	18	96.7	67.7	78	145.8	102.1	38	195.0	136.5	98	244.1	170.9
59	48.3	33.8	19	97.5	68.3	79	146.6	102.7	39	195.8	137.1	99	244.9	171.5
60	49.1	34.4	20	98.3	68.8	80	147.4	103.2	40	196.6	137.7	300	245.7	172.1
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 55 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	49.4	35.9	121	97.9	71.1	181	146.4	106.4	241	195.0	141.7
2	01.6	01.2	62	50.2	36.4	22	98.7	71.7	82	147.2	107.0	42	195.8	142.2
3	02.4	01.8	63	51.0	37.0	23	99.5	72.3	83	148.1	107.6	43	196.6	142.8
4	03.2	02.4	64	51.8	37.6	24	100.3	72.9	84	148.9	108.2	44	197.4	143.4
5	04.0	02.9	65	52.6	38.2	25	101.1	73.5	85	149.7	108.7	45	198.2	144.0
6	04.9	03.5	66	53.4	38.8	26	101.9	74.1	86	150.5	109.3	46	199.0	144.6
7	05.7	04.1	67	54.2	39.4	27	102.7	74.6	87	151.3	109.9	47	199.8	145.2
8	06.5	04.7	68	55.0	40.0	28	103.6	75.2	88	152.1	110.5	48	200.6	145.8
9	07.3	05.3	69	55.8	40.6	29	104.4	75.8	89	152.9	111.1	49	201.4	146.4
10	08.1	05.9	70	56.6	41.1	30	105.2	76.4	90	153.7	111.7	50	202.3	146.9
11	08.9	06.5	71	57.4	41.7	131	106.0	77.0	191	154.5	112.3	251	203.1	147.5
12	09.7	07.1	72	58.2	42.3	32	106.8	77.6	92	155.3	112.9	52	203.9	148.1
13	10.5	07.6	73	59.1	42.9	33	107.6	78.2	93	156.1	113.4	53	204.7	148.7
14	11.3	08.2	74	59.9	43.5	34	108.4	78.8	94	156.9	114.0	54	205.5	149.3
15	12.1	08.8	75	60.7	44.1	35	109.2	79.4	95	157.8	114.6	55	206.3	149.9
16	12.9	09.4	76	61.5	44.7	36	110.0	79.9	96	158.6	115.2	56	207.1	150.5
17	13.8	10.0	77	62.3	45.3	37	110.8	80.5	97	159.4	115.8	57	207.9	151.1
18	14.6	10.6	78	63.1	45.8	38	111.6	81.1	98	160.2	116.4	58	208.7	151.6
19	15.4	11.2	79	63.9	46.4	39	112.5	81.7	99	161.0	117.0	59	209.5	152.2
20	16.2	11.8	80	64.7	47.0	40	113.3	82.3	200	161.8	117.6	60	210.3	152.8
21	17.0	12.3	81	65.5	47.6	141	114.1	82.9	201	162.6	118.1	261	211.2	153.4
22	17.8	12.9	82	66.3	48.2	42	114.9	83.5	02	163.4	118.7	62	212.0	154.0
23	18.6	13.5	83	67.1	48.8	43	115.7	84.1	03	164.2	119.3	63	212.8	154.6
24	19.4	14.1	84	68.0	49.4	44	116.5	84.6	04	165.0	119.9	64	213.6	155.2
25	20.2	14.7	85	68.8	50.0	45	117.3	85.2	05	165.8	120.5	65	214.4	155.8
26	21.0	15.3	86	69.6	50.5	46	118.1	85.8	06	166.7	121.1	66	215.2	156.4
27	21.8	15.9	87	70.4	51.1	47	118.9	86.4	07	167.5	121.7	67	216.0	156.9
28	22.7	16.5	88	71.2	51.7	48	119.7	87.0	08	168.3	122.3	68	216.8	157.5
29	23.5	17.0	89	72.0	52.3	49	120.5	87.6	09	169.1	122.8	69	217.6	158.1
30	24.3	17.6	90	72.8	52.9	50	121.4	88.2	10	169.9	123.4	70	218.4	158.7
31	25.1	18.2	91	73.6	53.5	151	122.2	88.8	211	170.7	124.0	271	219.2	159.3
32	25.9	18.8	92	74.4	54.1	52	123.0	89.3	12	171.5	124.6	72	220.1	159.9
33	26.7	19.4	93	75.2	54.7	53	123.8	89.9	13	172.3	125.2	73	220.9	160.5
34	27.5	20.0	94	76.0	55.3	54	124.6	90.5	14	173.1	125.8	74	221.7	161.1
35	28.3	20.6	95	76.9	55.8	55	125.4	91.1	15	173.9	126.4	75	222.5	161.6
36	29.1	21.2	96	77.7	56.4	56	126.2	91.7	16	174.7	127.0	76	223.3	162.2
37	29.9	21.7	97	78.5	57.0	57	127.0	92.3	17	175.6	127.5	77	224.1	162.8
38	30.7	22.3	98	79.3	57.6	58	127.8	92.9	18	176.4	128.1	78	224.9	163.4
39	31.6	22.9	99	80.1	58.2	59	128.6	93.5	19	177.2	128.7	79	225.7	164.0
40	32.4	23.5	100	80.9	58.8	60	129.4	94.0	20	178.0	129.3	80	226.5	164.6
41	33.2	24.1	101	81.7	59.4	161	130.3	94.6	221	178.8	129.9	281	227.3	165.2
42	34.0	24.7	02	82.5	60.0	62	131.1	95.2	22	179.6	130.5	82	228.1	165.8
43	34.8	25.3	03	83.3	60.5	63	131.9	95.8	23	180.4	131.1	83	229.0	166.3
44	35.6	25.9	04	84.1	61.1	64	132.7	96.4	24	181.2	131.7	84	229.8	166.9
45	36.4	26.5	05	84.9	61.7	65	133.5	97.0	25	182.0	132.3	85	230.6	167.5
46	37.2	27.0	06	85.8	62.3	66	134.3	97.6	26	182.8	132.8	86	231.4	168.1
47	38.0	27.6	07	86.6	62.9	67	135.1	98.2	27	183.6	133.4	87	232.2	168.7
48	38.8	28.2	08	87.4	63.5	68	135.9	98.7	28	184.5	134.0	88	233.0	169.3
49	39.6	28.8	09	88.2	64.1	69	136.7	99.3	29	185.3	134.6	89	233.8	169.9
50	40.5	29.4	10	89.0	64.7	70	137.5	99.9	30	186.1	135.2	90	234.6	170.5
51	41.3	30.0	111	89.8	65.2	171	138.3	100.5	231	186.9	135.0	291	235.4	171.0
52	42.1	30.6	12	90.6	65.8	72	139.2	101.1	32	187.7	136.4	92	236.2	171.6
53	42.9	31.2	13	91.4	66.4	73	140.0	101.7	33	188.5	137.0	93	237.0	172.2
54	43.7	31.7	14	92.2	67.0	74	140.8	102.3	34	189.3	137.5	94	237.9	172.8
55	44.5	32.3	15	93.0	67.6	75	141.6	102.9	35	190.1	138.1	95	238.7	173.4
56	45.3	32.9	16	93.8	68.2	76	142.4	103.5	36	190.9	138.7	96	239.5	174.0
57	46.1	33.5	17	94.7	68.8	77	143.2	104.0	37	191.7	139.3	97	240.3	174.6
58	46.9	34.1	18	95.5	69.4	78	144.0	104.6	38	192.5	139.9	98	241.1	175.2
59	47.7	34.7	19	96.3	69.9	79	144.8	105.2	39	193.4	140.5	99	241.9	175.7
60	48.5	35.3	20	97.1	70.5	80	145.6	105.8	40	194.2	141.1	300	242.7	176.3
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 54 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	48.7	36.7	121	96.6	72.8	181	144.6	108.9	241	192.5	145.0
2	01.6	01.2	62	49.5	37.3	22	97.4	73.4	82	145.4	109.5	42	193.3	145.6
3	02.4	01.8	63	50.3	37.9	23	98.2	74.0	83	146.2	110.1	43	194.1	146.2
4	03.2	02.4	64	51.1	38.5	24	99.0	74.6	84	146.9	110.7	44	194.9	146.8
5	04.0	03.0	65	51.9	39.1	25	99.8	75.2	85	147.7	111.3	45	195.7	147.4
6	04.8	03.6	66	52.7	39.7	26	100.6	75.8	86	148.5	111.9	46	196.5	148.0
7	05.6	04.2	67	53.5	40.3	27	101.4	76.4	87	149.3	112.5	47	197.3	148.6
8	06.4	04.8	68	54.3	40.9	28	102.2	77.0	88	150.1	113.1	48	198.1	149.3
9	07.2	05.4	69	55.1	41.5	29	103.0	77.6	89	150.9	113.7	49	198.9	149.9
10	08.0	06.0	70	55.9	42.1	30	103.8	78.2	90	151.7	114.3	50	199.7	150.5
11	08.8	06.6	71	56.7	42.7	131	104.6	78.8	191	152.5	114.9	251	200.5	151.1
12	09.6	07.2	72	57.5	43.3	32	105.4	79.4	92	153.3	115.5	52	201.3	151.7
13	10.4	07.8	73	58.3	43.9	33	106.2	80.0	93	154.1	116.2	53	202.1	152.3
14	11.2	08.4	74	59.1	44.5	34	107.0	80.6	94	154.9	116.8	54	202.9	152.9
15	12.0	09.0	75	59.9	45.1	35	107.8	81.2	95	155.7	117.4	55	203.7	153.5
16	12.8	09.6	76	60.7	45.7	36	108.6	81.8	96	156.5	118.0	56	204.5	154.1
17	13.6	10.2	77	61.5	46.3	37	109.4	82.4	97	157.3	118.6	57	205.2	154.7
18	14.4	10.8	78	62.3	46.9	38	110.2	83.1	98	158.1	119.2	58	206.0	155.3
19	15.2	11.4	79	63.1	47.5	39	111.0	83.7	99	158.9	119.8	59	206.8	155.9
20	16.0	12.0	80	63.9	48.1	40	111.8	84.3	200	159.7	120.4	60	207.6	156.5
21	16.8	12.6	81	64.7	48.7	141	112.6	84.9	201	160.5	121.0	261	208.4	157.1
22	17.6	13.2	82	65.5	49.3	42	113.4	85.5	02	161.3	121.6	62	209.2	157.7
23	18.4	13.8	83	66.3	50.0	43	114.2	86.1	03	162.1	122.2	63	210.0	158.3
24	19.2	14.4	84	67.1	50.6	44	115.0	86.7	04	162.9	122.8	64	210.8	158.9
25	20.0	15.0	85	67.9	51.2	45	115.8	87.3	05	163.7	123.4	65	211.6	159.5
26	20.8	15.6	86	68.7	51.8	46	116.6	87.9	06	164.5	124.0	66	212.4	160.1
27	21.6	16.2	87	69.5	52.4	47	117.4	88.5	07	165.3	124.6	67	213.2	160.7
28	22.4	16.9	88	70.3	53.0	48	118.2	89.1	08	166.1	125.2	68	214.0	161.3
29	23.2	17.5	89	71.1	53.6	49	119.0	89.7	09	166.9	125.8	69	214.8	161.9
30	24.0	18.1	90	71.9	54.2	50	119.8	90.3	10	167.7	126.4	70	215.6	162.5
31	24.8	18.7	91	72.7	54.8	151	120.6	90.9	211	168.5	127.0	271	216.4	163.1
32	25.6	19.3	92	73.5	55.4	52	121.4	91.5	12	169.3	127.6	72	217.2	163.7
33	26.4	19.9	93	74.3	56.0	53	122.2	92.1	13	170.1	128.2	73	218.0	164.3
34	27.2	20.5	94	75.1	56.6	54	123.0	92.7	14	170.9	128.8	74	218.8	164.9
35	28.0	21.1	95	75.9	57.2	55	123.8	93.3	15	171.7	129.4	75	219.6	165.5
36	28.8	21.7	96	76.7	57.8	56	124.6	93.9	16	172.5	130.0	76	220.4	166.1
37	29.5	22.3	97	77.5	58.4	57	125.4	94.5	17	173.3	130.6	77	221.2	166.7
38	30.3	22.9	98	78.3	59.0	58	126.2	95.1	18	174.1	131.2	78	222.0	167.3
39	31.1	23.5	99	79.1	59.6	59	127.0	95.7	19	174.9	131.8	79	222.8	167.9
40	31.9	24.1	100	79.9	60.2	60	127.8	96.3	20	175.7	132.4	80	223.6	168.5
41	32.7	24.7	101	80.7	60.8	161	128.6	96.9	221	176.5	133.0	281	224.4	169.1
42	33.5	25.3	02	81.5	61.4	62	129.4	97.5	22	177.3	133.6	82	225.2	169.7
43	34.3	25.9	03	82.3	62.0	63	130.2	98.1	23	178.1	134.2	83	226.0	170.3
44	35.1	26.5	04	83.1	62.6	64	131.0	98.7	24	178.9	134.8	84	226.8	170.9
45	35.9	27.1	05	83.9	63.2	65	131.8	99.3	25	179.7	135.4	85	227.6	171.5
46	36.7	27.7	06	84.7	63.8	66	132.6	99.9	26	180.5	136.0	86	228.4	172.1
47	37.5	28.3	07	85.5	64.4	67	133.4	100.5	27	181.3	136.6	87	229.2	172.7
48	38.3	28.9	08	86.3	65.0	68	134.2	101.1	28	182.1	137.2	88	230.0	173.3
49	39.1	29.5	09	87.1	65.6	69	135.0	101.7	29	182.9	137.8	89	230.8	173.9
50	39.9	30.1	10	87.8	66.2	70	135.8	102.3	30	183.7	138.4	90	231.6	174.5
51	40.7	30.7	111	88.6	66.8	171	136.6	102.9	231	184.5	139.0	291	232.4	175.1
52	41.5	31.3	12	89.4	67.4	72	137.4	103.5	32	185.3	139.6	92	233.2	175.7
53	42.3	31.9	13	90.2	68.0	73	138.2	104.1	33	186.1	140.2	93	234.0	176.3
54	43.1	32.5	14	91.0	68.6	74	139.0	104.7	34	186.9	140.8	94	234.8	176.9
55	43.9	33.1	15	91.8	69.2	75	139.8	105.3	35	187.7	141.4	95	235.6	177.5
56	44.7	33.7	16	92.6	69.8	76	140.6	105.9	36	188.5	142.0	96	236.4	178.1
57	45.5	34.3	17	93.4	70.4	77	141.4	106.5	37	189.3	142.6	97	237.2	178.7
58	46.3	34.9	18	94.2	71.0	78	142.2	107.1	38	190.1	143.2	98	238.0	179.3
59	47.1	35.5	19	95.0	71.6	79	143.0	107.7	39	190.9	143.8	99	238.8	179.9
60	47.9	36.1	20	95.8	72.2	80	143.8	108.3	40	191.7	144.4	300	239.6	180.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 53 Degrees.

TABLE II. Difference of Latitude and Departure for 38 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	48.1	37.6	121	95.3	74.5	181	142.6	111.4	241	189.9	148.4
2	01.6	01.2	62	48.9	38.2	22	96.1	75.1	82	143.4	112.1	42	190.7	149.0
3	02.4	01.8	63	49.6	38.8	23	96.9	75.7	83	144.2	112.7	43	191.5	149.6
4	03.2	02.5	64	50.4	39.4	24	97.7	76.3	84	145.0	113.3	44	192.3	150.2
5	03.9	03.1	65	51.2	40.0	25	98.5	77.0	85	145.8	113.9	45	193.1	150.8
6	04.7	03.7	66	52.0	40.6	26	99.3	77.6	86	146.6	114.5	46	193.9	151.5
7	05.5	04.3	67	52.8	41.2	27	100.1	78.2	87	147.4	115.1	47	194.6	152.1
8	06.3	04.9	68	53.6	41.9	28	100.9	78.8	88	148.1	115.7	48	195.4	152.7
9	07.1	05.5	69	54.4	42.5	29	101.7	79.4	89	148.9	116.4	49	196.2	153.3
10	07.9	06.2	70	55.2	43.1	30	102.4	80.0	90	149.7	117.0	50	197.0	153.9
11	08.7	06.8	71	55.9	43.7	131	103.2	80.7	191	150.5	117.6	251	197.8	154.5
12	09.5	07.4	72	56.7	44.3	32	104.0	81.3	92	151.3	118.2	52	198.6	155.1
13	10.2	08.0	73	57.5	44.9	33	104.8	81.9	93	152.1	118.8	53	199.4	155.8
14	11.0	08.6	74	58.3	45.6	34	105.6	82.5	94	152.9	119.4	54	200.2	156.4
15	11.8	09.2	75	59.1	46.2	35	106.4	83.1	95	153.7	120.1	55	200.9	157.0
16	12.6	09.9	76	59.9	46.8	36	107.2	83.7	96	154.5	120.7	56	201.7	157.6
17	13.4	10.5	77	60.7	47.4	37	108.0	84.3	97	155.2	121.3	57	202.5	158.2
18	14.2	11.1	78	61.5	48.0	38	108.7	85.0	98	156.0	121.9	58	203.3	158.8
19	15.0	11.7	79	62.3	48.6	39	109.5	85.6	99	156.8	122.5	59	204.1	159.5
20	15.8	12.3	80	63.0	49.3	40	110.3	86.2	200	157.6	123.1	60	204.9	160.1
21	16.5	12.9	81	63.8	49.9	141	111.1	86.8	201	158.4	123.7	261	205.7	160.7
22	17.3	13.5	82	64.6	50.5	42	111.9	87.4	02	159.2	124.4	62	206.5	161.3
23	18.1	14.2	83	65.4	51.1	43	112.7	88.0	03	160.0	125.0	63	207.2	161.9
24	18.9	14.8	84	66.2	51.7	44	113.5	88.7	04	160.8	125.6	64	208.0	162.5
25	19.7	15.4	85	67.0	52.3	45	114.3	89.3	05	161.5	126.2	65	208.8	163.2
26	20.5	16.0	86	67.8	52.9	46	115.0	89.9	06	162.3	126.8	66	209.6	163.8
27	21.3	16.6	87	68.6	53.6	47	115.8	90.5	07	163.1	127.4	67	210.4	164.4
28	22.1	17.2	88	69.3	54.2	48	116.6	91.1	08	163.9	128.1	68	211.2	165.0
29	22.9	17.9	89	70.1	54.8	49	117.4	91.7	09	164.7	128.7	69	212.0	165.6
30	23.6	18.5	90	70.9	55.4	50	118.2	92.3	10	165.5	129.3	70	212.8	166.2
31	24.4	19.1	91	71.7	56.0	151	119.0	93.0	211	166.3	129.9	271	213.6	166.8
32	25.2	19.7	92	72.5	56.6	52	119.8	93.6	12	167.1	130.5	72	214.3	167.5
33	26.0	20.3	93	73.3	57.3	53	120.6	94.2	13	167.8	131.1	73	215.1	168.1
34	26.8	20.9	94	74.1	57.9	54	121.4	94.8	14	168.6	131.8	74	215.9	168.7
35	27.6	21.5	95	74.9	58.5	55	122.1	95.4	15	169.4	132.4	75	216.7	169.3
36	28.4	22.2	96	75.6	59.1	56	122.9	96.0	16	170.2	133.0	76	217.5	169.9
37	29.2	22.8	97	76.4	59.7	57	123.7	96.7	17	171.0	133.6	77	218.3	170.5
38	29.9	23.4	98	77.2	60.3	58	124.5	97.3	18	171.8	134.2	78	219.1	171.2
39	30.7	24.0	99	78.0	61.0	59	125.3	97.9	19	172.6	134.8	79	219.9	171.8
40	31.5	24.6	100	78.8	61.6	60	126.1	98.5	20	173.4	135.5	80	220.6	172.4
41	32.3	25.2	101	79.6	62.2	161	126.9	99.1	221	174.2	136.1	281	221.4	173.0
42	33.1	25.9	02	80.4	62.8	62	127.7	99.7	22	174.9	136.7	82	222.2	173.6
43	33.9	26.5	03	81.2	63.4	63	128.4	100.4	23	175.7	137.3	83	223.0	174.2
44	34.7	27.1	04	82.0	64.0	64	129.2	101.0	24	176.5	137.9	84	223.8	174.8
45	35.5	27.7	05	82.7	64.6	65	130.0	101.6	25	177.3	138.5	85	224.6	175.5
46	36.2	28.3	06	83.5	65.3	66	130.8	102.2	26	178.1	139.1	86	225.4	176.1
47	37.0	28.9	07	84.3	65.9	67	131.6	102.8	27	178.9	139.8	87	226.2	176.7
48	37.8	29.6	08	85.1	66.5	68	132.4	103.4	28	179.7	140.4	88	226.9	177.3
49	38.6	30.2	09	85.9	67.1	69	133.2	104.0	29	180.5	141.0	89	227.7	177.9
50	39.4	30.8	10	86.7	67.7	70	134.0	104.7	30	181.2	141.6	90	228.5	178.5
51	40.2	31.4	111	87.5	68.3	171	134.7	105.3	231	182.0	142.2	291	229.3	179.2
52	41.0	32.0	12	88.3	69.0	72	135.5	105.9	32	182.8	142.8	92	230.1	179.8
53	41.8	32.6	13	89.0	69.6	73	136.3	106.5	33	183.6	143.4	93	230.9	180.4
54	42.6	33.2	14	89.8	70.2	74	137.1	107.1	34	184.4	144.1	94	231.7	181.0
55	43.3	33.9	15	90.6	70.8	75	137.9	107.7	35	185.2	144.7	95	232.5	181.6
56	44.1	34.5	16	91.4	71.4	76	138.7	108.4	36	186.0	145.3	96	233.3	182.2
57	44.9	35.1	17	92.2	72.0	77	139.5	109.0	37	186.8	145.9	97	234.0	182.9
58	45.7	35.7	18	93.0	72.6	78	140.3	109.6	38	187.5	146.5	98	234.8	183.5
59	46.5	36.3	19	93.8	73.3	79	141.1	110.2	39	188.3	147.1	99	235.6	184.1
60	47.3	36.9	20	94.6	73.9	80	141.8	110.8	40	189.1	147.8	300	236.4	184.7
Dist.	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 52 Degrees.

TABLE II. Difference of Latitude and Departure for 39 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	47.4	38.4	121	94.0	76.1	181	140.7	113.9	241	187.3	151.7
2	01.6	01.3	62	48.2	39.0	22	94.8	76.8	82	141.4	114.5	42	188.1	152.3
3	02.3	01.9	63	49.0	39.6	23	95.6	77.4	83	142.2	115.2	43	188.8	152.9
4	03.1	02.5	64	49.7	40.3	24	96.4	78.0	84	143.0	115.8	44	189.6	153.6
5	03.9	03.1	65	50.5	40.9	25	97.1	78.7	85	143.8	116.4	45	190.4	154.2
6	04.7	03.8	66	51.3	41.5	26	97.9	79.3	86	144.5	117.1	46	191.2	154.8
7	05.4	04.4	67	52.1	42.2	27	98.7	79.9	87	145.3	117.7	47	192.0	155.4
8	06.2	05.0	68	52.8	42.8	28	99.5	80.6	88	146.1	118.3	48	192.7	156.1
9	07.0	05.7	69	53.6	43.4	29	100.3	81.2	89	146.9	118.9	49	193.5	156.7
10	07.8	06.3	70	54.4	44.1	30	101.0	81.8	90	147.7	119.6	50	194.3	157.3
11	08.5	06.9	71	55.2	44.7	131	101.8	82.4	191	148.4	120.2	251	195.1	158.0
12	09.3	07.6	72	56.0	45.3	32	102.6	83.1	92	149.2	120.8	52	195.8	158.6
13	10.1	08.2	73	56.7	45.9	33	103.4	83.7	93	150.0	121.5	53	196.6	159.2
14	10.9	08.8	74	57.5	46.6	34	104.1	84.3	94	150.8	122.1	54	197.4	159.8
15	11.7	09.4	75	58.3	47.2	35	104.9	85.0	95	151.5	122.7	55	198.2	160.5
16	12.4	10.1	76	59.1	47.8	36	105.7	85.6	96	152.3	123.3	56	198.9	161.1
17	13.2	10.7	77	59.8	48.5	37	106.5	86.2	97	153.1	124.0	57	199.7	161.7
18	14.0	11.3	78	60.6	49.1	38	107.2	86.8	98	153.9	124.6	58	200.5	162.4
19	14.8	12.0	79	61.4	49.7	39	108.0	87.5	99	154.7	125.2	59	201.3	163.0
20	15.5	12.6	80	62.2	50.3	40	108.8	88.1	200	155.4	125.9	60	202.1	163.6
21	16.3	13.2	81	62.9	51.0	141	109.6	88.7	201	156.2	126.5	261	202.8	164.3
22	17.1	13.8	82	63.7	51.6	42	110.4	89.4	02	157.0	127.1	62	203.6	164.9
23	17.9	14.5	83	64.5	52.2	43	111.1	90.0	03	157.8	127.8	63	204.4	165.5
24	18.7	15.1	84	65.3	52.9	44	111.9	90.6	04	158.5	128.4	64	205.2	166.1
25	19.4	15.7	85	66.1	53.5	45	112.7	91.3	05	159.3	129.0	65	205.9	166.8
26	20.2	16.4	86	66.8	54.1	46	113.5	91.9	06	160.1	129.6	66	206.7	167.4
27	21.0	17.0	87	67.6	54.8	47	114.2	92.5	07	160.9	130.3	67	207.5	168.0
28	21.8	17.6	88	68.4	55.4	48	115.0	93.1	08	161.6	130.9	68	208.3	168.7
29	22.5	18.3	89	69.2	56.0	49	115.8	93.8	09	162.4	131.5	69	209.1	169.3
30	23.3	18.9	90	69.9	56.6	50	116.6	94.4	10	163.2	132.2	70	209.8	169.9
31	24.1	19.5	91	70.7	57.3	151	117.3	95.0	211	164.0	132.8	271	210.6	170.5
32	24.9	20.1	92	71.5	57.9	52	118.1	95.7	12	164.8	133.4	72	211.4	171.2
33	25.6	20.8	93	72.3	58.5	53	118.9	96.3	13	165.5	134.0	73	212.2	171.8
34	26.4	21.4	94	73.1	59.2	54	119.7	96.9	14	166.3	134.7	74	212.9	172.4
35	27.2	22.0	95	73.8	59.8	55	120.5	97.5	15	167.1	135.3	75	213.7	173.1
36	28.0	22.7	96	74.6	60.4	56	121.2	98.2	16	167.9	135.9	76	214.5	173.7
37	28.8	23.3	97	75.4	61.0	57	122.0	98.8	17	168.6	136.6	77	215.3	174.3
38	29.5	23.9	98	76.2	61.7	58	122.8	99.4	18	169.4	137.2	78	216.0	175.0
39	30.3	24.5	99	76.9	62.3	59	123.6	100.1	19	170.2	137.8	79	216.8	175.6
40	31.1	25.2	100	77.7	62.9	60	124.3	100.7	20	171.0	138.5	80	217.6	176.2
41	31.9	25.8	101	78.5	63.6	161	125.1	101.3	221	171.7	139.1	281	218.4	176.8
42	32.6	26.4	02	79.3	64.2	62	125.9	101.9	22	172.5	139.7	82	219.2	177.5
43	33.4	27.1	03	80.0	64.8	63	126.7	102.6	23	173.3	140.3	83	219.9	178.1
44	34.2	27.7	04	80.8	65.4	64	127.5	103.2	24	174.1	141.0	84	220.7	178.7
45	35.0	28.3	05	81.6	66.1	65	128.2	103.8	25	174.9	141.6	85	221.5	179.4
46	35.7	28.9	06	82.4	66.7	66	129.0	104.5	26	175.6	142.2	86	222.3	180.0
47	36.5	29.6	07	83.2	67.3	67	129.8	105.1	27	176.4	142.9	87	223.0	180.6
48	37.3	30.2	08	83.9	68.0	68	130.6	105.7	28	177.2	143.5	88	223.8	181.2
49	38.1	30.8	09	84.7	68.6	69	131.3	106.4	29	178.0	144.1	89	224.6	181.9
50	38.9	31.5	10	85.5	69.2	70	132.1	107.0	30	178.7	144.7	90	225.4	182.5
51	39.6	32.1	111	86.3	69.9	171	132.9	107.6	231	179.5	145.4	291	226.1	183.1
52	40.4	32.7	12	87.0	70.5	72	133.7	108.2	32	180.3	146.0	92	226.9	183.8
53	41.2	33.4	13	87.8	71.1	73	134.4	108.9	33	181.1	146.6	93	227.7	184.4
54	42.0	34.0	14	88.6	71.7	74	135.2	109.5	34	181.9	147.3	94	228.5	185.0
55	42.7	34.6	15	89.4	72.4	75	136.0	110.1	35	182.6	147.9	95	229.3	185.6
56	43.5	35.2	16	90.1	73.0	76	136.8	110.8	36	183.4	148.5	96	230.0	186.3
57	44.3	35.9	17	90.9	73.6	77	137.6	111.4	37	184.2	149.1	97	230.8	186.9
58	45.1	36.5	18	91.7	74.3	78	138.3	112.0	38	185.0	149.8	98	231.6	187.5
59	45.9	37.1	19	92.5	74.9	79	139.1	112.6	39	185.7	150.4	99	232.4	188.2
60	46.6	37.8	20	93.3	75.5	80	139.9	113.3	40	186.5	151.0	300	233.1	188.8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 51 Degrees.

TABLE II. Difference of Latitude and Departure for 40 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	46.7	39.2	121	92.7	77.8	181	138.7	116.3	241	184.6	154.9
2	01.5	01.3	62	47.5	39.9	22	93.5	78.4	82	139.4	117.0	42	185.4	155.6
3	02.3	01.9	63	48.3	40.5	23	94.2	79.1	83	140.2	117.6	43	186.1	156.2
4	03.1	02.6	64	49.0	41.1	24	95.0	79.7	84	141.0	118.3	44	186.9	156.8
5	03.8	03.2	65	49.8	41.8	25	95.7	80.3	85	141.7	118.9	45	187.7	157.5
6	04.6	03.9	66	50.6	42.4	26	96.5	81.0	86	142.5	119.6	46	188.4	158.1
7	05.4	04.5	67	51.3	43.1	27	97.3	81.6	87	143.2	120.2	47	189.2	158.8
8	06.1	05.1	68	52.1	43.7	28	98.1	82.3	88	144.0	120.8	48	190.0	159.4
9	06.9	05.8	69	52.9	44.4	29	98.8	82.9	89	144.8	121.5	49	190.7	160.1
10	07.7	06.4	70	53.6	45.0	30	99.6	83.6	90	145.5	122.1	50	191.5	160.7
11	08.4	07.1	71	54.4	45.6	131	100.4	84.2	191	146.3	122.8	251	192.3	161.3
12	09.2	07.7	72	55.2	46.3	32	101.1	84.8	92	147.1	123.4	52	193.0	162.0
13	10.0	08.4	73	55.9	46.9	33	101.9	85.5	93	147.8	124.1	53	193.8	162.6
14	10.7	09.0	74	56.7	47.6	34	102.6	86.1	94	148.6	124.7	54	194.6	163.3
15	11.5	09.6	75	57.5	48.2	35	103.4	86.8	95	149.4	125.3	55	195.3	163.9
16	12.3	10.3	76	58.2	48.9	36	104.2	87.4	96	150.1	126.0	56	196.1	164.6
17	13.0	10.9	77	59.0	49.5	37	104.9	88.1	97	150.9	126.6	57	196.9	165.2
18	13.8	11.6	78	59.8	50.1	38	105.7	88.7	98	151.7	127.3	58	197.6	165.9
19	14.6	12.2	79	60.5	50.8	39	106.5	89.3	99	152.4	127.9	59	198.4	166.5
20	15.3	12.9	80	61.3	51.4	40	107.2	90.0	200	153.2	128.6	60	199.2	167.1
21	16.1	13.5	81	62.0	52.1	141	108.0	90.6	201	154.0	129.2	261	199.9	167.8
22	16.9	14.1	82	62.8	52.7	42	108.8	91.3	02	154.7	129.8	62	200.7	168.4
23	17.6	14.8	83	63.6	53.4	43	109.5	91.9	03	155.5	130.5	63	201.5	169.1
24	18.4	15.4	84	64.3	54.0	44	110.3	92.6	04	156.3	131.1	64	202.2	169.7
25	19.2	16.1	85	65.1	54.6	45	111.1	93.2	05	157.0	131.8	65	203.0	170.3
26	19.9	16.7	86	65.9	55.3	46	111.8	93.8	06	157.8	132.4	66	203.8	171.0
27	20.7	17.4	87	66.6	55.9	47	112.6	94.5	07	158.6	133.1	67	204.5	171.6
28	21.4	18.0	88	67.4	56.6	48	113.4	95.1	08	159.3	133.7	68	205.3	172.3
29	22.2	18.6	89	68.2	57.2	49	114.1	95.8	09	160.1	134.3	69	206.1	172.9
30	23.0	19.3	90	68.9	57.9	50	114.9	96.4	10	160.9	135.0	70	206.8	173.6
31	23.7	19.9	91	69.7	58.5	151	115.7	97.1	211	161.6	135.6	271	207.6	174.2
32	24.5	20.6	92	70.5	59.1	52	116.4	97.7	12	162.4	136.3	72	208.4	174.8
33	25.3	21.2	93	71.2	59.8	53	117.2	98.3	13	163.2	136.9	73	209.1	175.5
34	26.0	21.9	94	72.0	60.4	54	118.0	99.0	14	163.9	137.6	74	209.9	176.1
35	26.8	22.5	95	72.8	61.1	55	118.7	99.6	15	164.7	138.2	75	210.6	176.8
36	27.6	23.1	96	73.5	61.7	56	119.5	100.3	16	165.5	138.8	76	211.4	177.4
37	28.3	23.8	97	74.3	62.4	57	120.3	100.9	17	166.2	139.5	77	212.2	178.1
38	29.1	24.4	98	75.1	63.0	58	121.0	101.6	18	167.0	140.1	78	213.0	178.7
39	29.9	25.1	99	75.8	63.6	59	121.8	102.2	19	167.8	140.8	79	213.7	179.3
40	30.6	25.7	100	76.6	64.3	60	122.6	102.8	20	168.5	141.4	80	214.5	180.0
41	31.4	26.4	101	77.4	64.9	161	123.3	103.5	221	169.3	142.1	281	215.3	180.6
42	32.2	27.0	02	78.1	65.6	62	124.1	104.1	22	170.1	142.7	82	216.0	181.3
43	32.9	27.6	03	78.9	66.2	63	124.9	104.8	23	170.8	143.3	83	216.8	181.9
44	33.7	28.3	04	79.7	66.8	64	125.6	105.4	24	171.6	144.0	84	217.6	182.6
45	34.5	28.9	05	80.4	67.5	65	126.4	106.1	25	172.4	144.6	85	218.3	183.2
46	35.2	29.6	06	81.2	68.1	66	127.2	106.7	26	173.1	145.3	86	219.1	183.8
47	36.0	30.2	07	82.0	68.8	67	127.9	107.3	27	173.9	145.9	87	219.9	184.5
48	36.8	30.9	08	82.7	69.4	68	128.7	108.0	28	174.7	146.6	88	220.6	185.1
49	37.5	31.5	09	83.5	70.1	69	129.5	108.6	29	175.4	147.2	89	221.4	185.8
50	38.3	32.1	10	84.3	70.7	70	130.2	109.3	30	176.2	147.8	90	222.2	186.4
51	39.1	32.8	111	85.0	71.3	171	131.0	109.9	231	177.0	148.5	291	222.9	187.1
52	39.8	33.4	12	85.8	72.0	72	131.8	110.6	32	177.7	149.1	92	223.7	187.7
53	40.6	34.1	13	86.6	72.6	73	132.5	111.2	33	178.5	149.8	93	224.4	188.3
54	41.4	34.7	14	87.3	73.3	74	133.3	111.8	34	179.3	150.4	94	225.2	189.0
55	42.1	35.4	15	88.1	73.9	75	134.1	112.5	35	180.0	151.1	95	226.0	189.6
56	42.9	36.0	16	88.9	74.6	76	134.8	113.1	36	180.8	151.7	96	226.7	190.3
57	43.7	36.6	17	89.6	75.2	77	135.6	113.8	37	181.6	152.3	97	227.5	190.9
58	44.4	37.3	18	90.4	75.8	78	136.4	114.4	38	182.3	153.0	98	228.3	191.6
59	45.2	37.9	19	91.2	76.5	79	137.1	115.1	39	183.1	153.6	99	229.0	192.2
60	46.0	38.6	20	91.9	77.1	80	137.9	115.7	40	183.8	154.3	300	229.8	192.8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 50 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.7	61	46.0	40.0	121	91.3	79.4	181	136.6	118.7	141	181.9	158.1
2	01.5	01.3	62	46.8	40.7	22	92.1	80.0	82	137.4	119.4	42	182.6	158.8
3	02.3	02.0	63	47.5	41.3	23	92.8	80.7	83	138.1	120.1	43	183.4	159.4
4	03.0	02.6	64	48.3	42.0	24	93.6	81.4	84	138.9	120.7	44	184.1	160.1
5	03.8	03.3	65	49.1	42.6	25	94.3	82.0	85	139.6	121.4	45	184.9	160.7
6	04.5	03.9	66	49.8	43.3	26	95.1	82.7	86	140.4	122.0	46	185.7	161.4
7	05.3	04.6	67	50.6	44.0	27	95.8	83.3	87	141.1	122.7	47	186.4	162.0
8	06.1	05.2	68	51.3	44.6	28	96.6	84.0	88	141.9	123.3	48	187.2	162.7
9	06.8	05.9	69	52.1	45.3	29	97.4	84.6	89	142.6	124.0	49	187.9	163.4
10	07.5	06.6	70	52.8	45.9	30	98.1	85.3	90	143.4	124.7	50	188.7	164.0
11	08.3	07.2	71	53.6	46.6	131	98.9	85.9	191	144.1	125.3	251	189.4	164.6
12	09.1	07.9	72	54.3	47.2	32	99.6	86.6	92	144.9	126.0	52	190.2	165.3
13	09.8	08.5	73	55.1	47.9	33	100.4	87.3	93	145.7	126.6	53	190.9	166.0
14	10.6	09.2	74	55.8	48.5	34	101.1	87.9	94	146.4	127.3	54	191.7	166.6
15	11.3	09.8	75	56.6	49.2	35	101.9	88.6	95	147.2	127.9	55	192.5	167.3
16	12.1	10.5	76	57.4	49.9	36	102.6	89.2	96	147.9	128.6	56	193.2	168.0
17	12.8	11.2	77	58.1	50.5	37	103.4	89.9	97	148.7	129.2	57	194.0	168.6
18	13.6	11.8	78	58.9	51.2	38	104.1	90.5	98	149.4	129.9	58	194.7	169.3
19	14.3	12.5	79	59.6	51.8	39	104.9	91.2	99	150.2	130.6	59	195.5	169.9
20	15.1	13.1	80	60.4	52.5	40	105.7	91.8	200	150.9	131.2	60	196.2	170.5
21	15.8	13.8	81	61.1	53.1	141	106.4	92.5	201	151.7	131.9	261	197.0	171.2
22	16.6	14.4	82	61.9	53.8	42	107.2	93.2	02	152.5	132.5	62	197.7	171.9
23	17.4	15.1	83	62.6	54.5	43	107.9	93.8	03	153.2	133.2	63	198.5	172.5
24	18.1	15.7	84	63.4	55.1	44	108.7	94.5	04	154.0	133.8	64	199.2	173.2
25	18.9	16.4	85	64.2	55.8	45	109.4	95.1	05	154.7	134.5	65	200.0	173.9
26	19.6	17.1	86	64.9	56.4	46	110.2	95.8	06	155.5	135.1	66	200.8	174.5
27	20.4	17.7	87	65.7	57.1	47	110.9	96.4	07	156.2	135.8	67	201.5	175.2
28	21.1	18.4	88	66.4	57.7	48	111.7	97.1	08	157.0	136.5	68	202.3	175.8
29	21.9	19.0	89	67.2	58.4	49	112.5	97.8	09	157.7	137.1	69	203.0	176.5
30	22.6	19.7	90	67.9	59.0	50	113.2	98.4	10	158.5	137.8	70	203.8	177.1
31	23.4	20.3	91	68.7	59.7	151	114.0	99.1	211	159.2	138.4	271	204.5	177.8
32	24.2	21.0	92	69.4	60.4	52	114.7	99.7	12	160.0	139.1	72	205.3	178.4
33	24.9	21.6	93	70.2	61.0	53	115.5	100.4	13	160.8	139.7	73	206.0	179.1
34	25.7	22.3	94	70.9	61.7	54	116.2	101.0	14	161.5	140.4	74	206.8	179.8
35	26.4	23.0	95	71.7	62.3	55	117.0	101.7	15	162.3	141.1	75	207.5	180.4
36	27.2	23.6	96	72.5	63.0	56	117.7	102.3	16	163.0	141.7	76	208.3	181.1
37	27.9	24.3	97	73.2	63.6	57	118.5	103.0	17	163.8	142.4	77	209.1	181.7
38	28.7	24.9	98	74.0	64.3	58	119.2	103.7	18	164.5	143.0	78	209.8	182.4
39	29.4	25.6	99	74.7	64.9	59	120.0	104.3	19	165.3	143.7	79	210.6	183.0
40	30.2	26.2	100	75.5	65.6	60	120.8	105.0	20	166.0	144.3	80	211.3	183.7
41	30.9	26.9	101	76.2	66.3	161	121.5	105.6	221	166.8	145.0	281	212.1	184.4
42	31.7	27.6	02	77.0	66.9	62	122.3	106.3	22	167.5	145.6	82	212.8	185.0
43	32.5	28.2	03	77.7	67.6	63	123.0	106.9	23	168.3	146.3	83	213.6	185.7
44	33.2	28.9	04	78.5	68.2	64	123.8	107.6	24	169.1	147.0	84	214.3	186.3
45	34.0	29.5	05	79.2	68.9	65	124.5	108.2	25	169.8	147.6	85	215.1	187.0
46	34.7	30.2	06	80.0	69.5	66	125.3	108.9	26	170.6	148.3	86	215.8	187.6
47	35.5	30.8	07	80.8	70.2	67	126.0	109.6	27	171.3	148.9	87	216.6	188.3
48	36.2	31.5	08	81.5	70.9	68	126.8	110.2	28	172.1	149.6	88	217.4	188.9
49	37.0	32.1	09	82.3	71.5	69	127.5	110.9	29	172.8	150.2	89	218.1	189.6
50	37.7	32.8	10	83.0	72.2	70	128.3	111.5	30	173.6	150.9	90	218.9	190.3
51	38.5	33.5	111	83.8	72.8	171	129.1	112.2	231	174.3	151.5	291	219.6	190.9
52	39.2	34.1	12	84.5	73.5	72	129.8	112.8	32	175.1	152.2	92	220.4	191.6
53	40.0	34.8	13	85.3	74.1	73	130.6	113.5	33	175.8	152.9	93	221.1	192.2
54	40.8	35.4	14	86.0	74.8	74	131.3	114.2	34	176.6	153.5	94	221.9	192.9
55	41.5	36.1	15	86.8	75.4	75	132.1	114.8	35	177.4	154.2	95	222.6	193.5
56	42.3	36.7	16	87.5	76.1	76	132.8	115.5	36	178.1	154.8	96	223.4	194.2
57	43.0	37.4	17	88.3	76.8	77	133.6	116.1	37	178.9	155.5	97	224.1	194.8
58	43.8	38.1	18	89.1	77.4	78	134.3	116.8	38	179.6	156.1	98	224.9	195.5
59	44.5	38.7	19	89.8	78.1	79	135.1	117.4	39	180.4	156.8	99	225.7	196.2
60	45.3	39.4	20	90.6	78.7	80	135.8	118.1	40	181.1	157.5	300	226.4	196.8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 49 Degrees

TABLE II. Difference of Latitude and Departure for 42 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.7	00.7	61	45.3	40.8	121	89.9	81.0	181	134.5	121.1	241	179.1	161.3
2	01.5	01.3	62	46.1	41.5	22	90.7	81.6	82	135.3	121.8	42	179.8	161.9
3	02.2	02.0	63	46.8	42.2	23	91.4	82.3	83	136.0	122.5	43	180.6	162.6
4	03.0	02.7	64	47.6	42.8	24	92.1	83.0	84	136.7	123.1	44	181.3	163.3
5	03.7	03.3	65	48.3	43.5	25	92.9	83.6	85	137.5	123.8	45	182.1	163.9
6	04.5	04.0	66	49.0	44.2	26	93.6	84.3	86	138.2	124.5	46	182.8	164.6
7	05.2	04.7	67	49.8	44.8	27	94.4	85.0	87	139.0	125.1	47	183.6	165.3
8	05.9	05.4	68	50.5	45.5	28	95.1	85.6	88	139.7	125.8	48	184.3	165.9
9	06.7	06.0	69	51.3	46.2	29	95.9	86.3	89	140.5	126.5	49	185.1	166.6
10	07.4	06.7	70	52.0	46.8	30	96.6	87.0	90	141.2	127.1	50	185.8	167.3
11	08.2	07.4	71	52.8	47.5	131	97.4	87.7	191	141.9	127.8	251	186.5	168.0
12	08.9	08.0	72	53.5	48.2	32	98.1	88.3	92	142.7	128.5	52	187.3	168.6
13	09.7	08.7	73	54.2	48.8	33	98.8	89.0	93	143.4	129.1	53	188.0	169.3
14	10.4	09.4	74	55.0	49.5	34	99.6	89.7	94	144.2	129.8	54	188.8	170.0
15	11.1	10.0	75	55.7	50.2	35	100.3	90.3	95	144.9	130.5	55	189.5	170.6
16	11.9	10.7	76	56.5	50.8	36	101.1	91.0	96	145.7	131.1	56	190.2	171.3
17	12.6	11.4	77	57.2	51.5	37	101.8	91.7	97	146.4	131.8	57	191.0	172.0
18	13.4	12.0	78	58.0	52.2	38	102.6	92.3	98	147.1	132.5	58	191.7	172.6
19	14.1	12.7	79	58.7	52.9	39	103.3	93.0	99	147.9	133.2	59	192.5	173.3
20	14.9	13.4	80	59.5	53.5	40	104.0	93.7	200	148.6	133.8	60	193.2	174.0
21	15.6	14.1	81	60.2	54.2	141	104.8	94.3	201	149.4	134.5	261	194.0	174.6
22	16.3	14.7	82	60.9	54.9	42	105.5	95.0	02	150.1	135.2	62	194.7	175.3
23	17.1	15.4	83	61.7	55.5	43	106.3	95.7	03	150.9	135.8	63	195.4	176.0
24	17.8	16.1	84	62.4	56.2	44	107.0	96.4	04	151.6	136.5	64	196.2	176.7
25	18.6	16.7	85	63.2	56.9	45	107.8	97.0	05	152.3	137.2	65	196.9	177.3
26	19.3	17.4	86	63.9	57.5	46	108.5	97.7	06	153.1	137.8	66	197.7	178.0
27	20.1	18.1	87	64.7	58.2	47	109.2	98.4	07	153.8	138.5	67	198.4	178.7
28	20.8	18.7	88	65.4	58.9	48	110.0	99.0	08	154.6	139.2	68	199.2	179.3
29	21.6	19.4	89	66.1	59.6	49	110.7	99.7	09	155.3	139.8	69	199.9	180.0
30	22.3	20.1	90	66.9	60.2	50	111.4	100.4	10	156.1	140.5	70	200.6	180.7
31	23.0	20.7	91	67.6	60.9	151	112.2	101.0	211	156.8	141.2	271	201.4	181.3
32	23.8	21.4	92	68.4	61.6	52	113.0	101.7	12	157.5	141.9	72	202.1	182.0
33	24.5	22.1	93	69.1	62.2	53	113.7	102.4	13	158.3	142.5	73	202.9	182.7
34	25.3	22.8	94	69.9	62.9	54	114.4	103.0	14	159.0	143.2	74	203.6	183.3
35	26.0	23.4	95	70.6	63.6	55	115.2	103.7	15	159.8	143.9	75	204.4	184.0
36	26.8	24.1	96	71.3	64.2	56	115.9	104.4	16	160.5	144.5	76	205.1	184.7
37	27.5	24.8	97	72.1	64.9	57	116.7	105.1	17	161.3	145.2	77	205.9	185.3
38	28.2	25.4	98	72.8	65.6	58	117.4	105.7	18	162.0	145.9	78	206.6	186.0
39	29.0	26.1	99	73.6	66.2	59	118.2	106.4	19	162.7	146.5	79	207.3	186.7
40	29.7	26.8	100	74.3	66.9	60	118.9	107.1	20	163.5	147.2	80	208.1	187.4
41	30.5	27.4	101	75.0	67.6	161	119.6	107.7	221	164.2	147.9	281	208.8	188.0
42	31.2	28.1	02	75.8	68.3	62	120.4	108.4	22	165.0	148.5	82	209.6	188.7
43	32.0	28.8	03	76.5	68.9	63	121.1	109.1	23	165.7	149.2	83	210.3	189.4
44	32.7	29.4	04	77.3	69.6	64	121.9	109.7	24	166.5	149.9	84	211.1	190.0
45	33.4	30.1	05	78.0	70.3	65	122.6	110.4	25	167.2	150.6	85	211.8	190.7
46	34.2	30.8	06	78.8	70.9	66	123.3	111.1	26	168.0	151.2	86	212.5	191.4
47	34.9	31.4	07	79.5	71.6	67	124.1	111.7	27	168.7	151.9	87	213.3	192.0
48	35.7	32.1	08	80.3	72.3	68	124.8	112.4	28	169.4	152.6	88	214.0	192.7
49	36.4	32.8	09	81.0	72.9	69	125.6	113.1	29	170.2	153.2	89	214.8	193.4
50	37.2	33.5	10	81.7	73.6	70	126.3	113.8	30	170.9	153.9	90	215.5	194.0
51	37.9	34.1	111	82.5	74.3	171	127.0	114.4	231	171.7	154.6	291	216.3	194.7
52	38.6	34.8	12	83.2	74.9	72	127.8	115.1	32	172.4	155.2	92	217.0	195.4
53	39.4	35.5	13	84.0	75.6	73	128.6	115.8	33	173.2	155.9	93	217.7	196.1
54	40.1	36.1	14	84.7	76.3	74	129.3	116.4	34	173.9	156.6	94	218.5	196.7
55	40.9	36.8	15	85.5	77.0	75	130.1	117.1	35	174.6	157.2	95	219.2	197.4
56	41.6	37.5	16	86.2	77.6	76	130.8	117.8	36	175.4	157.9	96	220.0	198.1
57	42.4	38.1	17	86.9	78.3	77	131.5	118.4	37	176.1	158.6	97	220.7	198.7
58	43.1	38.8	18	87.7	79.0	78	132.3	119.1	38	176.9	159.3	98	221.5	199.4
59	43.8	39.5	19	88.4	79.6	79	133.0	119.8	39	177.6	159.9	99	222.2	200.1
60	44.6	40.1	20	89.2	80.3	80	133.8	120.4	40	178.4	160.6	300	222.9	200.7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 48 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.7	00.7	61	44.6	41.6	121	88.5	82.5	181	132.4	123.4	241	176.3	164.4
2	01.5	01.4	62	45.3	42.3	22	89.2	83.2	82	133.1	124.1	42	177.0	165.0
3	02.2	02.0	63	46.1	43.0	23	90.0	83.9	83	133.8	124.8	43	177.7	165.7
4	02.9	02.7	64	46.8	43.6	24	90.7	84.6	84	134.6	125.5	44	178.5	166.4
5	03.7	03.4	65	47.5	44.3	25	91.4	85.2	85	135.3	126.2	45	179.2	167.1
6	04.4	04.1	66	48.3	45.0	26	92.2	85.9	86	136.0	126.9	46	179.9	167.8
7	05.1	04.8	67	49.0	45.7	27	92.9	86.6	87	136.8	127.5	47	180.6	168.5
8	05.9	05.5	68	49.7	46.4	28	93.6	87.3	88	137.5	128.2	48	181.4	169.1
9	06.6	06.1	69	50.5	47.1	29	94.3	88.0	89	138.2	128.9	49	182.1	169.8
10	07.3	06.8	70	51.2	47.7	30	95.1	88.7	90	139.0	129.6	50	182.8	170.5
11	08.0	07.5	71	51.9	48.4	131	95.8	89.3	191	139.7	130.3	251	183.6	171.2
12	08.8	08.2	72	52.7	49.1	32	96.5	90.0	92	140.4	130.9	52	184.3	171.9
13	09.5	08.9	73	53.4	49.8	33	97.3	90.7	93	141.2	131.6	53	185.0	172.5
14	10.2	09.5	74	54.1	50.5	34	98.0	91.4	94	141.9	132.3	54	185.8	173.2
15	11.0	10.2	75	54.9	51.1	35	98.7	92.1	95	142.6	133.0	55	186.5	173.9
16	11.7	10.9	76	55.6	51.8	36	99.5	92.8	96	143.3	133.7	56	187.2	174.6
17	12.4	11.6	77	56.3	52.5	37	100.2	93.4	97	144.1	134.4	57	188.0	175.3
18	13.2	12.3	78	57.0	53.2	38	100.9	94.1	98	144.8	135.0	58	188.7	176.0
19	13.9	13.0	79	57.8	53.9	39	101.7	94.8	99	145.5	135.7	59	189.4	176.6
20	14.6	13.6	80	58.5	54.6	40	102.4	95.5	200	146.3	136.4	60	190.2	177.3
21	15.4	14.3	81	59.2	55.2	141	103.1	96.2	201	147.0	137.1	261	190.9	178.0
22	16.1	15.0	82	60.0	55.9	42	103.9	96.8	02	147.7	137.8	62	191.6	178.7
23	16.8	15.7	83	60.7	56.6	43	104.6	97.5	03	148.5	138.4	63	192.3	179.4
24	17.6	16.4	84	61.4	57.3	44	105.3	98.2	04	149.2	139.1	64	193.1	180.0
25	18.3	17.0	85	62.2	58.0	45	106.0	98.9	05	149.9	139.8	65	193.8	180.7
26	19.0	17.7	86	62.9	58.7	46	106.8	99.6	06	150.7	140.5	66	194.5	181.4
27	19.7	18.4	87	63.6	59.3	47	107.5	100.3	07	151.4	141.2	67	195.3	182.1
28	20.5	19.1	88	64.4	60.0	48	108.2	100.9	08	152.1	141.9	68	196.0	182.8
29	21.2	19.8	89	65.1	60.7	49	109.0	101.6	09	152.9	142.5	69	196.7	183.5
30	21.9	20.5	90	65.8	61.4	50	109.7	102.3	10	153.6	143.2	70	197.5	184.1
31	22.7	21.1	91	66.6	62.1	151	110.4	103.0	211	154.3	143.9	271	198.2	184.8
32	23.4	21.8	92	67.3	62.7	52	111.2	103.7	12	155.0	144.6	72	198.9	185.5
33	24.1	22.5	93	68.0	63.4	53	111.9	104.3	13	155.8	145.3	73	199.7	186.2
34	24.9	23.2	94	68.7	64.1	54	112.6	105.0	14	156.5	145.9	74	200.4	186.9
35	25.6	23.9	95	69.5	64.8	55	113.4	105.7	15	157.2	146.6	75	201.1	187.5
36	26.3	24.6	96	70.2	65.5	56	114.1	106.4	16	158.0	147.3	76	201.9	188.2
37	27.1	25.2	97	70.9	66.2	57	114.8	107.1	17	158.7	148.0	77	202.6	188.9
38	27.8	25.9	98	71.7	66.8	58	115.6	107.8	18	159.4	148.7	78	203.3	189.6
39	28.5	26.6	99	72.4	67.5	59	116.3	108.4	19	160.2	149.4	79	204.0	190.3
40	29.3	27.3	100	73.1	68.2	60	117.0	109.1	20	160.9	150.0	80	204.8	191.0
41	30.0	28.0	101	73.9	68.9	161	117.7	109.8	221	161.6	150.7	281	205.5	191.6
42	30.7	28.6	02	74.6	69.6	62	118.5	110.5	22	162.4	151.4	82	206.2	192.3
43	31.4	29.3	03	75.3	70.2	63	119.2	111.2	23	163.1	152.1	83	207.0	193.0
44	32.2	30.0	04	76.1	70.9	64	119.9	111.8	24	163.8	152.8	84	207.7	193.7
45	32.9	30.7	05	76.8	71.6	65	120.7	112.5	25	164.6	153.4	85	208.4	194.4
46	33.6	31.4	06	77.5	72.3	66	121.4	113.2	26	165.3	154.1	86	209.2	195.1
47	34.4	32.1	07	78.3	73.0	67	122.1	113.9	27	166.0	154.8	87	209.9	195.7
48	35.1	32.7	08	79.0	73.7	68	122.9	114.6	28	166.7	155.5	88	210.6	196.4
49	35.8	33.4	09	79.7	74.3	69	123.6	115.3	29	167.5	156.2	89	211.4	197.1
50	36.6	34.1	10	80.4	75.0	70	124.3	115.9	30	168.2	156.9	90	212.1	197.8
51	37.3	34.8	111	81.2	75.7	171	125.1	116.6	231	168.9	157.5	291	212.8	198.5
52	38.0	35.5	12	81.9	76.4	72	125.8	117.3	32	169.7	158.2	92	213.6	199.1
53	38.8	36.1	13	82.6	77.1	73	126.5	118.0	33	170.4	158.9	93	214.3	199.8
54	39.5	36.8	14	83.4	77.7	74	127.3	118.7	34	171.1	159.6	94	215.0	200.5
55	40.2	37.5	15	84.1	78.4	75	128.0	119.3	35	171.9	160.3	95	215.7	201.2
56	41.0	38.2	16	84.8	79.1	76	128.7	120.0	36	172.6	161.0	96	216.5	201.9
57	41.7	38.9	17	85.6	79.8	77	129.4	120.7	37	173.3	161.6	97	217.2	202.6
58	42.4	39.6	18	86.3	80.5	78	130.2	121.4	38	174.1	162.3	98	217.9	203.2
59	43.1	40.2	19	87.0	81.2	79	130.9	122.1	39	174.8	163.0	99	218.7	203.9
60	43.9	40.9	20	87.8	81.8	80	131.6	122.8	40	175.5	163.7	300	219.4	204.6
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 47 Degrees.

Table II. Difference of Latitude and Departure for 44 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.7	00.7	61	43.9	42.4	121	87.0	84.1	181	130.2	125.7	241	173.4	167.4
2	01.4	01.4	62	44.6	43.1	22	87.8	84.7	82	130.9	126.4	42	174.1	168.1
3	02.2	02.1	63	45.3	43.8	23	88.5	85.4	83	131.6	127.1	43	174.8	168.8
4	02.9	02.8	64	46.0	44.5	24	89.2	86.1	84	132.4	127.8	44	175.5	169.5
5	03.6	03.5	65	46.8	45.2	25	89.9	86.8	85	133.1	128.5	45	176.2	170.2
6	04.3	04.2	66	47.5	45.8	26	90.6	87.5	86	133.8	129.2	46	177.0	170.9
7	05.0	04.9	67	48.2	46.5	27	91.4	88.2	87	134.5	129.9	47	177.7	171.6
8	05.8	05.6	68	48.9	47.2	28	92.1	88.9	88	135.2	130.6	48	178.4	172.3
9	06.5	06.3	69	49.6	47.9	29	92.8	89.6	89	136.0	131.3	49	179.1	173.0
10	07.2	06.9	70	50.4	48.6	30	93.5	90.3	90	136.7	132.0	50	179.8	173.7
11	07.9	07.6	71	51.1	49.3	131	94.2	91.0	191	137.4	132.7	251	180.6	174.4
12	08.6	08.3	72	51.8	50.0	32	95.0	91.7	92	138.1	133.4	52	181.3	175.1
13	09.4	09.0	73	52.5	50.7	33	95.7	92.4	93	138.8	134.1	53	182.0	175.7
14	10.1	09.7	74	53.2	51.4	34	96.4	93.1	94	139.6	134.8	54	182.7	176.4
15	10.8	10.4	75	54.0	52.1	35	97.1	93.8	95	140.3	135.5	55	183.4	177.1
16	11.5	11.1	76	54.7	52.8	36	97.8	94.5	96	141.0	136.2	56	184.2	177.8
17	12.2	11.8	77	55.4	53.5	37	98.5	95.2	97	141.7	136.8	57	184.9	178.5
18	12.9	12.5	78	56.1	54.2	38	99.3	95.9	98	142.4	137.5	58	185.6	179.2
19	13.7	13.2	79	56.8	54.9	39	100.0	96.6	99	143.1	138.2	59	186.3	179.9
20	14.4	13.9	80	57.5	55.6	40	100.7	97.3	200	143.9	138.9	60	187.0	180.6
21	15.1	14.6	81	58.3	56.3	141	101.4	97.9	201	144.6	139.6	261	187.7	181.3
22	15.8	15.3	82	59.0	57.0	42	102.1	98.6	02	145.3	140.3	62	188.5	182.0
23	16.5	16.0	83	59.7	57.7	43	102.9	99.3	03	146.0	141.0	63	189.2	182.7
24	17.3	16.7	84	60.4	58.4	44	103.6	100.0	04	146.7	141.7	64	189.9	183.4
25	18.0	17.4	85	61.1	59.0	45	104.3	100.7	05	147.5	142.4	65	190.6	184.1
26	18.7	18.1	86	61.9	59.7	46	105.0	101.4	06	148.2	143.1	66	191.3	184.8
27	19.4	18.8	87	62.6	60.4	47	105.7	102.1	07	148.9	143.8	67	192.1	185.5
28	20.1	19.5	88	63.3	61.1	48	106.5	102.8	08	149.6	144.5	68	192.8	186.2
29	20.9	20.1	89	64.0	61.8	49	107.2	103.5	09	150.3	145.2	69	193.5	186.6
30	21.6	20.8	90	64.7	62.5	50	107.9	104.2	10	151.1	145.9	70	194.2	187.6
31	22.3	21.5	91	65.5	63.2	151	108.6	104.9	211	151.8	146.6	271	194.9	188.3
32	23.0	22.2	92	66.2	63.9	52	109.3	105.6	12	152.5	147.3	72	195.7	188.9
33	23.7	22.9	93	66.9	64.6	53	110.1	106.3	13	153.2	148.0	73	196.4	189.6
34	24.5	23.6	94	67.6	65.3	54	110.8	107.0	14	153.9	148.7	74	197.1	190.3
35	25.2	24.3	95	68.3	66.0	55	111.5	107.7	15	154.7	149.3	75	197.8	191.0
36	25.9	25.0	96	69.1	66.7	56	112.2	108.4	16	155.4	150.0	76	198.5	191.7
37	26.6	25.7	97	69.8	67.4	57	112.9	109.1	17	156.1	150.7	77	199.3	192.4
38	27.3	26.4	98	70.5	68.1	58	113.7	109.8	18	156.8	151.4	78	200.0	193.1
39	28.1	27.1	99	71.2	68.8	59	114.4	110.5	19	157.5	152.1	79	200.7	193.8
40	28.8	27.8	100	71.9	69.5	60	115.1	111.1	20	158.3	152.8	80	201.4	194.5
41	29.5	28.5	101	72.7	70.2	161	115.8	111.8	221	159.0	153.5	281	202.1	195.2
42	30.2	29.2	02	73.4	70.9	62	116.5	112.5	22	159.7	154.2	82	202.9	195.9
43	30.9	29.9	03	74.1	71.5	63	117.3	113.2	23	160.4	154.9	83	203.6	196.6
44	31.7	30.6	04	74.8	72.2	64	118.0	113.9	24	161.1	155.6	84	204.3	197.3
45	32.4	31.3	05	75.5	72.9	65	118.7	114.6	25	161.9	156.3	85	205.0	198.0
46	33.1	32.0	06	76.3	73.6	66	119.4	115.3	26	162.6	157.0	86	205.7	198.7
47	33.8	32.6	07	77.0	74.3	67	120.1	116.0	27	163.3	157.7	87	206.5	199.4
48	34.5	33.3	08	77.7	75.0	68	120.8	116.7	28	164.0	158.4	88	207.2	200.1
49	35.2	34.0	09	78.4	75.7	69	121.6	117.4	29	164.7	159.1	89	207.9	200.8
50	36.0	34.7	10	79.1	76.4	70	122.3	118.1	30	165.4	159.8	90	208.6	201.5
51	36.7	35.4	111	79.8	77.1	171	123.0	118.8	231	166.2	160.5	291	209.3	202.1
52	37.4	36.1	12	80.6	77.8	72	123.7	119.5	32	166.9	161.2	92	210.0	202.8
53	38.1	36.8	13	81.3	78.5	73	124.4	120.2	33	167.6	161.8	93	210.8	203.5
54	38.8	37.5	14	82.0	79.2	74	125.2	120.9	34	168.3	162.6	94	211.5	204.2
55	39.6	38.2	15	82.7	79.9	75	125.9	121.6	35	169.0	163.2	95	212.2	204.9
56	40.3	38.9	16	83.4	80.6	76	126.6	122.3	36	169.8	163.9	96	212.9	205.6
57	41.0	39.6	17	84.2	81.3	77	127.3	123.0	37	170.5	164.6	97	213.6	206.3
58	41.7	40.3	18	84.9	82.0	78	128.0	123.6	38	171.2	165.3	98	214.4	207.0
59	42.4	41.0	19	85.6	82.7	79	128.8	124.3	39	171.9	166.0	99	215.1	207.7
60	43.2	41.7	20	86.3	83.4	80	129.5	125.0	40	172.6	166.7	300	215.8	208.4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 46 Degrees.

TABLE II. Difference of Latitude and Departure for 45 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.7	00.7	61	43.1	43.1	121	85.6	85.6	181	128.0	128.0	241	170.4	170.4
2	01.4	01.4	62	43.8	43.8	22	86.3	86.3	82	128.7	128.7	42	171.1	171.1
3	02.1	02.1	63	44.5	44.5	23	87.0	87.0	83	129.4	129.4	43	171.8	171.8
4	02.8	02.8	64	45.3	45.3	24	87.7	87.7	84	130.1	130.1	44	172.5	172.5
5	03.5	03.5	65	46.0	46.0	25	88.4	88.4	85	130.8	130.8	45	173.2	173.2
6	04.2	04.2	66	46.7	46.7	26	89.1	89.1	86	131.5	131.5	46	173.9	173.9
7	04.9	04.9	67	47.4	47.4	27	89.8	89.8	87	132.2	132.2	47	174.7	174.7
8	05.7	05.7	68	48.1	48.1	28	90.5	90.5	88	132.9	132.9	48	175.4	175.4
9	06.4	06.4	69	48.8	48.8	29	91.2	91.2	89	133.6	133.6	49	176.1	176.1
10	07.1	07.1	70	49.5	49.5	30	91.9	91.9	90	134.4	134.4	50	176.8	176.8
11	07.8	07.8	71	50.2	50.2	131	92.6	92.6	191	135.1	135.1	251	177.5	177.5
12	08.5	08.5	72	50.9	50.9	32	93.3	93.3	92	135.8	135.8	52	178.2	178.2
13	09.2	09.2	73	51.6	51.6	33	94.0	94.0	93	136.5	136.5	53	178.9	178.9
14	09.9	09.9	74	52.3	52.3	34	94.8	94.8	94	137.2	137.2	54	179.6	179.6
15	10.6	10.6	75	53.0	53.0	35	95.5	95.5	95	137.9	137.9	55	180.3	180.3
16	11.3	11.3	76	53.7	53.7	36	96.2	96.2	96	138.6	138.6	56	181.0	181.0
17	12.0	12.0	77	54.4	54.4	37	96.9	96.9	97	139.3	139.3	57	181.7	181.7
18	12.7	12.7	78	55.2	55.2	38	97.6	97.6	98	140.0	140.0	58	182.4	182.4
19	13.4	13.4	79	55.9	55.9	39	98.3	98.3	99	140.7	140.7	59	183.1	183.1
20	14.1	14.1	80	56.6	56.6	40	99.0	99.0	200	141.4	141.4	60	183.8	183.8
21	14.8	14.8	81	57.3	57.3	141	99.7	99.7	201	142.1	142.1	261	184.6	184.6
22	15.6	15.6	82	58.0	58.0	42	100.4	100.4	02	142.8	142.8	62	185.3	185.3
23	16.3	16.3	83	58.7	58.7	43	101.1	101.1	03	143.5	143.5	63	186.0	186.0
24	17.0	17.0	84	59.4	59.4	44	101.8	101.8	04	144.2	144.2	64	186.7	186.7
25	17.7	17.7	85	60.1	60.1	45	102.5	102.5	05	145.0	145.0	65	187.4	187.4
26	18.4	18.4	86	60.8	60.8	46	103.2	103.2	06	145.7	145.7	66	188.1	188.1
27	19.1	19.1	87	61.5	61.5	47	103.9	103.9	07	146.4	146.4	67	188.8	188.8
28	19.8	19.8	88	62.2	62.2	48	104.7	104.7	08	147.1	147.1	68	189.5	189.5
29	20.5	20.5	89	62.9	62.9	49	105.4	105.4	09	147.8	147.8	69	190.2	190.2
30	21.2	21.2	90	63.6	63.6	50	106.1	106.1	10	148.5	148.5	70	190.9	190.9
31	21.9	21.9	91	64.3	64.3	151	106.8	106.8	211	149.2	149.2	271	191.6	191.6
32	22.6	22.6	92	65.1	65.1	52	107.5	107.5	12	149.9	149.9	72	192.3	192.3
33	23.3	23.3	93	65.8	65.8	53	108.2	108.2	13	150.6	150.6	73	193.0	193.0
34	24.0	24.0	94	66.5	66.5	54	108.9	108.9	14	151.3	151.3	74	193.7	193.7
35	24.7	24.7	95	67.2	67.2	55	109.6	109.6	15	152.0	152.0	75	194.5	194.5
36	25.5	25.5	96	67.9	67.9	56	110.3	110.3	16	152.7	152.7	76	195.2	195.2
37	26.2	26.2	97	68.6	68.6	57	111.0	111.0	17	153.4	153.4	77	195.9	195.9
38	26.9	26.9	98	69.3	69.3	58	111.7	111.7	18	154.1	154.1	78	196.6	196.6
39	27.6	27.6	99	70.0	70.0	59	112.4	112.4	19	154.9	154.9	79	197.3	197.3
40	28.3	28.3	100	70.7	70.7	60	113.1	113.1	20	155.6	155.6	80	198.0	198.0
41	29.0	29.0	101	71.4	71.4	161	113.8	113.8	221	156.3	156.3	281	198.7	198.7
42	29.7	29.7	02	72.1	72.1	62	114.6	114.6	22	157.0	157.0	82	199.4	199.4
43	30.4	30.4	03	72.8	72.8	63	115.3	115.3	23	157.7	157.7	83	200.1	200.1
44	31.1	31.1	04	73.5	73.5	64	116.0	116.0	24	158.4	158.4	84	200.8	200.8
45	31.8	31.8	05	74.2	74.2	65	116.7	116.7	25	159.1	159.1	85	201.5	201.5
46	32.5	32.5	06	75.0	75.0	66	117.4	117.4	26	159.8	159.8	86	202.2	202.2
47	33.2	33.2	07	75.7	75.7	67	118.1	118.1	27	160.5	160.5	87	202.9	202.9
48	33.9	33.9	08	76.4	76.4	68	118.8	118.8	28	161.2	161.2	88	203.6	203.6
49	34.6	34.6	09	77.1	77.1	69	119.5	119.5	29	161.9	161.9	89	204.4	204.4
50	35.4	35.4	10	77.8	77.8	70	120.2	120.2	30	162.6	162.6	90	205.1	205.1
51	36.1	36.1	111	78.5	78.5	171	120.9	120.9	231	163.3	163.3	291	205.8	205.8
52	36.8	36.8	12	79.2	79.2	72	121.6	121.6	32	164.0	164.0	92	206.5	206.5
53	37.5	37.5	13	79.9	79.9	73	122.3	122.3	33	164.8	164.8	93	207.2	207.2
54	38.2	38.2	14	80.6	80.6	74	123.0	123.0	34	165.5	165.5	94	207.9	207.9
55	38.9	38.9	15	81.3	81.3	75	123.7	123.7	35	166.2	166.2	95	208.6	208.6
56	39.6	39.6	16	82.0	82.0	76	124.5	124.5	36	166.9	166.9	96	209.3	209.3
57	40.3	40.3	17	82.7	82.7	77	125.2	125.2	37	167.6	167.6	97	210.0	210.0
58	41.0	41.0	18	83.4	83.4	78	125.9	125.9	38	168.3	168.3	98	210.7	210.7
59	41.7	41.7	19	84.1	84.1	79	126.6	126.6	39	169.0	169.0	99	211.4	211.4
60	42.4	42.4	20	84.9	84.9	80	127.3	127.3	40	169.7	169.7	300	212.1	212.1
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 45 Degrees.

Table III.

Of Logarithmic Sines, Tangents, and Secants, to every Point and Quarter-Point of the Compass.

Points.	Sines.	Co-sines.	Tangents.	Co-tang.	Secant.	Co-secant	Points.
0	0.00000	10.00000	0.00000	Infinite.	10.00000	Infinite.	8
0 ¼	8.69080	9.99947	8.69132	11.30868	10.00052	11.30921	7 ¾
0 ½	8.99130	9.99790	8.99340	11.00660	10.00210	11.00870	7 ½
0 ¾	9.16652	9.99527	9.17125	10.82875	10.00473	10.83348	7 ¼
1	9.29024	9.99157	9.29866	10.70134	10.00843	10.70976	7
1 ¼	9.38557	9.98679	9.39878	10.60122	10.01321	10.61443	6 ¾
1 ½	9.46282	9.98088	9.48194	10.51806	10.01912	10.53718	6 ½
1 ¾	9.52749	9.97384	9.55365	10.44635	10.02616	10.47251	6 ¼
2	9.58284	9.96562	9.61722	10.38278	10.03438	10.41716	6
2 ¼	9.63099	9.95616	9.67483	10.32517	10.04384	10.36901	5 ¾
2 ½	9.67339	9.94543	9.72796	10.27204	10.05457	10.32661	5 ½
2 ¾	9.71105	9.93335	9.77770	10.22230	10.06665	10.28895	5 ¼
3	9.74474	9.91985	9.82489	10.17511	10.08015	10.25526	5
3 ¼	9.77503	9.90483	9.87020	10.12980	10.09517	10.22497	4 ¾
3 ½	9.80236	9.88819	9.91417	10.08583	10.11181	10.19764	4 ½
3 ¾	9.82708	9.86979	9.95729	10.04271	10.13021	10.17292	4 ¼
4	9.84948	9.84948	10.00000	10.00000	10.15052	10.15052	4
	Co-sines.	Sines.	Co-tang.	Tangents.	Co-secant	Secant.	

Table IV.

A Table of Logarithms from 1 to 10,000.

No.	Log.	No.	Log.	No.	Log.	No.	Log.	No.	Log.
1	0.00000	21	1.32222	41	1.61278	61	1.78533	81	1.90849
2	30103	22	34242	42	62325	62	79239	82	91381
3	47712	23	36173	43	63347	63	79934	83	91908
4	60206	24	38021	44	64345	64	80618	84	92428
5	69897	25	39794	45	65321	65	81291	85	92942
6	77815	26	41497	46	66276	66	81954	86	93450
7	84510	27	43136	47	67210	67	82607	87	93952
8	90309	28	44716	48	68124	68	83251	88	94448
9	95424	29	46240	49	69020	69	83885	89	94939
10	1.00000	30	47712	50	69897	70	84510	90	95424
11	1.04139	31	1.49136	51	1.70757	71	1.85126	91	1.95904
12	07918	32	50515	52	71600	72	85733	92	96379
13	11394	33	51851	53	72428	73	86332	93	96848
14	14613	34	53148	54	73239	74	86923	94	97313
15	17609	35	54407	55	74036	75	87506	95	97772
16	20412	36	55630	56	74819	76	88081	96	98227
17	23045	37	56820	57	75587	77	88649	97	98677
18	25527	38	57978	58	76343	78	89209	98	99123
19	27875	39	59106	59	77085	79	89763	99	99564
20	30103	40	60206	60	77815	80	90309	100	2.00000

A Table of Logarithms from 1 to 10,000.

0	1	2	3	4	5	6	7	8	9
2.00000	2.00043	2.00087	2.00130	2.00173	2.00217	2.00260	2.00303	2.00346	2.00389
00432	00475	00518	00561	00604	00647	00689	00732	00775	00817
00860	00903	00945	00988	01030	01072	01115	01157	01199	01242
01284	01326	01368	01410	01452	01494	01536	01578	01620	01662
01703	01745	01787	01828	01870	01912	01953	01995	02036	02078
02119	02160	02202	02243	02284	02325	02366	02407	02449	02490
02531	02572	02612	02653	02694	02735	02776	02816	02857	02898
02938	02979	03019	03060	03100	03141	03181	03222	03262	03302
03342	03383	03423	03463	03503	03543	03583	03623	03663	03703
03743	03782	03822	03862	03902	03941	03981	04021	04060	04100
2.04139	2.04179	2.04218	2.04258	2.04297	2.04336	2.04376	2.04415	2.04454	2.04493
04532	04571	04610	04650	04689	04727	04766	04805	04844	04883
04922	04961	04999	05038	05077	05115	05154	05192	05231	05269
05308	05346	05385	05423	05461	05500	05538	05576	05614	05652
05690	05729	05767	05805	05843	05881	05918	05956	05994	06032
06070	06108	06145	06183	06221	06258	06296	06333	06371	06408
06446	06483	06521	06558	06595	06633	06670	06707	06744	06781
06819	06856	06893	06930	06967	07004	07041	07078	07115	07151
07188	07225	07262	07298	07335	07372	07408	07445	07482	07518
07555	07591	07628	07664	07700	07737	07773	07809	07846	07882
2.07918	2.07954	2.07990	2.08027	2.08063	2.08099	2.08135	2.08171	2.08207	2.08243
08279	08314	08350	08386	08422	08458	08493	08529	08565	08600
08636	08672	08707	08743	08778	08814	08849	08884	08920	08955
08991	09026	09061	09096	09132	09167	09202	09237	09272	09307
09342	09377	09412	09447	09482	09517	09552	09587	09621	09656
09691	09726	09760	09795	09830	09864	09899	09934	09968	10003
10037	10072	10106	10140	10175	10209	10243	10278	10312	10346
10380	10415	10449	10483	10517	10551	10585	10619	10653	10687
10721	10755	10789	10823	10857	10890	10924	10598	10992	11025
11059	11093	11126	11160	11193	11227	11261	11294	11327	11361
2.11394	2.11428	2.11461	2.11494	2.11528	2.11561	2.11594	2.11628	2.11661	2.11694
11727	11760	11793	11826	11860	11893	11926	11959	11992	12024
12057	12090	12123	12156	12189	12222	12254	12287	12320	12352
12385	12418	12450	12483	12516	12548	12581	12613	12646	12678
12710	12743	12775	12808	12840	12872	12905	12937	12969	13001
13033	13066	13098	13130	13162	13194	13226	13258	13290	13322
13354	13386	13418	13450	13481	13513	13545	13577	13609	13640
13672	13704	13735	13767	13799	13830	13862	13893	13925	13956
13988	14019	14051	14082	14114	14145	14176	14208	14239	14270
14301	14333	14364	14395	14426	14457	14489	14520	14551	14582
2.14613	2.14644	2.14675	2.14706	2.14737	2.14768	2.14799	2.14829	2.14860	2.14891
14922	14953	14983	15014	15045	15076	15106	15137	15168	15198
15229	15259	15290	15320	15351	15381	15412	15442	15473	15503
15534	15564	15594	15625	15655	15685	15715	15746	15776	15806
15836	15866	15897	15927	15957	15987	16017	16047	16077	16107
16137	16167	16197	16227	16256	16286	16316	16346	16376	16406
16435	16465	16495	16524	16554	16584	16613	16643	16673	16702
16732	16761	16791	16820	16850	16879	16909	16938	16967	16997
17026	17056	17085	17114	17143	17173	17202	17231	17260	17289
17319	17348	17377	17406	17435	17464	17493	17522	17551	17580
2.17609	2.17638	2.17667	2.17696	2.17725	2.17754	2.17782	2.17811	2.17840	2.17869
17898	17926	17955	17984	18013	18041	18070	18099	18127	18156
18184	18213	18241	18270	18298	18327	18355	18384	18412	18441
18469	18498	18526	18554	18583	18611	18639	18667	18696	18724
18752	18780	18808	18837	18865	18893	18921	18949	18977	19005
19033	19061	19089	19117	19145	19173	19201	19229	19257	19285
19312	19340	19368	19396	19424	19451	19479	19507	19535	19562
19590	19618	19645	19673	19700	19728	19756	19783	19811	19838
19866	19893	19921	19948	19976	20003	20030	20058	20085	20112
20140	20167	20194	20222	20249	20276	20303	20330	20358	20385

A Table of Logarithms from 1 to 10,000.

N°	0	1	2	3	4	5	6	7	8	9
160	2.20412	2.20439	2.20466	2.20493	2.20520	2.20548	2.20575	2.20602	2.20629	2.20656
61	20683	20710	20737	20763	20790	20817	20844	20871	20898	20925
62	20951	20978	21005	21032	21059	21085	21112	21139	21165	21192
63	21219	21245	21272	21299	21325	21352	21378	21405	21431	21458
64	21484	21511	21537	21564	21590	21617	21643	21669	21696	21722
65	21748	21775	21801	21827	21854	21880	21906	21932	21958	21985
66	22011	22037	22063	22089	22115	22141	22167	22194	22220	22246
67	22272	22298	22324	22350	22376	22401	22427	22453	22479	22505
68	22531	22557	22583	22608	22634	22660	22686	22712	22737	22763
69	22789	22814	22840	22866	22891	22917	22943	22968	22994	23019
170	2.23045	2.23070	2.23096	2.23121	2.23147	2.23172	2.23198	2.23223	2.23249	2.23274
71	23300	23325	23350	23376	23401	23426	23452	23477	23502	23528
72	23553	23578	23603	23629	23654	23679	23704	23729	23754	23779
73	23805	23830	23855	23880	23905	23930	23955	23980	24005	24030
74	24055	24080	24105	24130	24155	24180	24204	24229	24254	24279
75	24304	24329	24353	24378	24403	24428	24452	24477	24502	24527
76	24551	24576	24601	24625	24650	24674	24999	24724	24748	24773
77	24797	24822	24846	24871	24895	24920	24944	24969	24993	25018
78	25042	25066	25091	25115	25139	25164	25188	25212	25237	25261
79	25285	25310	25334	25358	25382	25406	25431	25455	25479	25503
180	2.25327	2.25551	2.25575	2.25600	2.25624	2.25648	2.25672	2.25696	2.25720	2.25744
81	25768	25792	25816	25840	25864	25888	25912	25935	25959	25983
82	26007	26031	26055	26079	26102	26126	26150	26174	26198	26221
83	26245	26269	26293	26316	26340	26364	26387	26411	26435	26458
84	26482	26505	26529	26553	26576	26600	26623	26647	26670	26694
85	26717	26741	26764	26788	26811	26834	26858	26881	26905	26928
86	26951	26975	26998	27021	27045	27068	27091	27114	27138	27161
87	27184	27207	27231	27254	27277	27300	27323	27346	27370	27393
88	27416	27439	27462	27485	27508	27531	27754	27577	27600	27623
89	27646	27669	27692	27715	27738	27761	27574	27807	27830	27852
190	2.27875	2.27898	2.27921	2.27944	2.27967	2.27989	2.28012	2.28035	2.28058	2.28081
91	28103	28126	28149	28171	28194	28217	28240	28262	28285	28307
92	28330	28353	28375	28398	28421	28443	28466	28488	28511	28533
93	28556	28578	28601	28623	28646	28668	28691	28713	28735	28758
94	28780	28803	28825	28847	28870	28892	28914	28937	28959	28981
95	29003	29026	29048	29070	29092	29115	29137	29159	29181	29203
96	29226	29248	29270	29292	29314	29336	29358	29380	29403	29425
97	29447	29469	29491	29513	29535	29557	29579	29601	29623	29645
98	29667	29688	29710	29732	29754	29776	29798	29820	29842	29863
99	29885	29907	29929	29951	29973	29994	30016	30038	30060	30081
200	2.30103	2.30125	2.30146	2.30168	2.30190	2.30211	2.30233	2.30255	2.30276	2.30298
01	30320	30341	30363	30384	30406	30428	30449	30471	30492	30514
02	30535	30557	30578	30600	30621	30643	30664	30685	30707	30728
03	30750	30771	30792	30814	30835	30856	30878	30899	30920	30942
04	30963	30984	31006	31027	31048	31069	31091	31112	31133	31154
05	31175	31197	31218	31239	31260	31281	31302	31323	31345	31366
06	31387	31408	31429	31450	31471	31492	31513	31534	31555	31576
07	31597	31618	31639	31660	31681	31702	31723	31744	31765	31785
08	31806	31827	31848	31869	31890	31911	31931	31952	31973	31994
09	32015	32035	32056	32077	32098	32118	32139	32160	32181	32201
210	2.32222	2.32243	2.32263	2.32284	2.32305	2.32325	2.32346	3.32366	2.32387	2.32408
11	32428	32449	32469	32490	32510	32531	32552	32572	32593	32613
12	32634	32654	32675	32695	32715	32736	32756	32777	32797	32818
13	32838	32858	32879	32899	32919	32940	32960	32980	33001	33021
14	33041	33062	33082	33102	33122	33143	33163	33183	33203	33224
15	33244	33264	33284	33304	33325	33345	33365	33385	33405	33425
16	33445	33465	33486	33506	33526	33546	33566	33586	33606	33626
17	33646	33666	33686	33706	33726	33746	33766	33786	33806	33826
18	33846	33866	33885	33905	33925	33945	33965	33985	34005	34025
19	34044	34064	34084	34104	34124	34143	34163	34183	34203	34223

A Table of Logarithms from 1 to 10,000.

N°	0	1	2	3	4	5	6	7	8	9
220	2.34242	1.34262	2.34282	2.34301	2.34321	2.34341	2.34361	2.34380	2.34400	2.34420
21	34439	34459	34479	34498	34518	34537	34557	34577	34596	34616
22	34635	34655	34674	34694	34713	34733	34753	34772	34792	34811
23	34830	34050	34869	34889	34908	34928	34947	34967	34986	35005
24	35025	35044	35064	35083	35102	35122	35141	35160	35180	35199
25	35218	35238	35257	35276	35295	35315	35334	35353	35372	35392
26	35411	35430	35449	35468	35488	35507	35526	35545	35564	35583
27	35603	35622	35641	35660	35679	35698	35717	35736	35755	35774
28	35793	35813	35832	35851	35870	35889	35908	35927	35946	35965
29	35984	36003	36021	36040	36059	36078	36097	36116	36135	36154
230	2.36173	2.36192	1.36211	2.36229	2.36248	2.36267	2.36286	2.36305	2.36324	2.36342
31	36361	36380	36399	36418	36436	36455	36474	36493	36511	36530
32	36549	36561	36580	36605	36624	36642	36661	36680	36698	36717
33	36736	36754	36773	36791	36810	36829	36847	36866	36884	36903
34	36922	36940	36959	36977	36996	37014	37033	37051	37070	37088
35	37107	37125	37144	37162	37181	37199	37218	37236	37254	37273
36	37291	37310	37328	37346	37365	37383	37401	37420	37438	37457
37	37475	37493	37511	37530	37548	37566	37585	37603	37621	37639
38	37658	37676	37694	37712	37731	37749	37767	37785	37803	37822
39	37840	37858	37876	37894	37912	37931	37949	37967	37985	38003
240	2.38021	4.38039	2.38057	2.38075	2.38093	2.38112	2.38130	2.38148	2.38166	2.38184
41	38202	38220	38238	38256	38274	38292	38310	38328	38346	38364
42	38382	38399	38417	38435	38453	38471	38489	38507	38525	38543
43	38561	38578	38596	38614	38632	38650	38668	38686	38703	38721
44	38739	38757	38775	38792	38810	38828	38846	38863	38881	38899
45	38917	38934	38952	38970	38987	39005	39023	39041	39058	39076
46	39094	39111	39129	39146	39164	39182	39199	39217	39235	39252
47	39270	39287	39305	39322	39340	39358	39375	39393	39410	39428
48	39445	39463	39480	39498	39515	39533	39550	39568	39585	39602
49	39620	39637	39655	39672	39690	39707	39724	39742	39759	39777
250	2.39749	2.39811	2.39829	2.39846	2.39863	2.39881	2.39898	2.39915	2.39933	2.39950
51	39967	39985	40002	40019	40037	40054	40071	40088	40106	40123
52	40140	40157	40175	40192	40209	40226	40243	40261	40278	40295
53	40312	40329	40346	40364	40381	40398	40415	40432	40449	40466
54	40483	40500	40518	40535	40552	40569	40586	40603	40620	40637
55	40654	40671	40688	40705	40722	40739	40756	40773	40790	40807
56	40824	40841	40858	40875	40892	40909	40926	40943	40960	40976
57	40993	41010	41027	41044	41061	41078	41095	41111	41128	41145
58	41162	41179	41196	41212	41229	41246	41263	41280	41296	41313
59	41330	41347	41363	41380	41397	41414	41430	41447	41464	41481
260	2.41497	2.41514	2.41531	2.41547	2.41564	2.41581	2.41597	2.41614	2.41631	2.41647
61	41664	41681	41697	41714	41731	41747	41764	41780	41797	41814
62	41830	41847	41863	41880	41896	41913	41929	41946	41963	41979
63	41996	42012	42029	42045	42062	42078	42095	42111	42127	42144
64	42160	42177	42193	42210	42226	42243	42259	42275	42292	42308
65	42325	42341	42357	42374	42390	42406	42423	42439	42455	42472
66	42488	42504	42521	42537	42553	42570	42586	42602	42619	42635
67	42651	42667	42684	42700	42716	42732	42749	42765	42781	42797
68	42813	42830	42846	42862	42878	42894	42911	42927	42943	42959
69	42975	42991	43008	43024	43040	43056	43072	43088	43104	43120
270	2.43136	2.43152	2.43169	2.43185	2.43201	2.43217	2.43233	2.43249	1.43265	2.43281
71	43297	43313	43329	43345	43361	43377	43393	43409	43425	43441
72	43457	43473	43489	43505	43521	43537	43553	43569	43584	43600
73	43616	43632	43648	43664	43680	43696	43712	43727	43743	43759
74	43775	43791	43807	43823	43838	43854	43870	43886	43902	43917
75	43933	43949	43965	43981	43996	44012	44028	44044	44059	44075
76	44091	44107	44122	44138	44154	44170	44185	44201	44217	44232
77	44248	44264	44279	44295	44311	44326	44342	44358	44373	44389
78	44404	44420	44436	44451	44467	44483	44498	44514	44529	44545
79	44560	45576	44592	44607	44623	44638	44654	44669	44685	44700

TABLE IV.

A Table of Logarithms from 1 to 10,000.

N°	0	1	2	3	4	5	6	7	8	9
880	2.94448	2.94453	2.94458	2.94463	2.94468	2.94473	2.94478	2.94483	2.94488	2.94493
81	94498	94503	94507	94512	94517	94522	94527	94532	94537	94542
82	94547	94552	94557	94562	94567	94571	94576	94581	94586	94591
83	94596	94601	94606	94611	94616	94621	94626	94630	94635	94640
84	94645	94650	94655	94660	94665	94670	94675	94680	94685	94689
85	94694	94699	94704	94709	94714	94719	94724	94729	94734	94738
86	94743	94748	94753	94758	94763	94768	94773	94778	94783	94787
87	94792	94797	94802	94807	94812	94817	94822	94827	94832	94836
88	94841	94846	94851	94856	94861	94866	94871	94876	94880	94885
89	94890	94895	94900	94905	94910	94915	94919	94924	94929	94934
890	2.94939	2.94944	2.94949	2.94954	2.94959	2.94963	2.94968	2.94973	2.94978	2.94983
91	94988	94993	94998	95002	95007	95012	95017	95022	95027	95032
92	95036	95041	95046	95051	95056	95061	95066	95071	95075	95080
93	95085	95090	95095	95100	95105	95109	95114	95119	95124	95129
94	95134	95139	95143	95148	95153	95158	95163	95168	95173	95177
95	95182	95187	95192	95197	95202	95207	95211	95216	95221	95226
96	95231	95236	95240	95245	95250	95255	95260	95265	95270	95274
97	95279	95284	95289	95294	95299	95303	95308	95313	95318	95323
98	95328	95332	95337	95342	95347	95352	95357	95361	95366	95371
99	95376	95381	95386	95390	95395	95400	95405	95410	95415	95419
900	2.95424	2.95429	2.95434	2.95439	2.95444	2.95448	2.95453	2.95758	2.95463	2.95468
01	95472	95477	95482	95487	95492	95497	95501	95506	95511	95516
02	95521	95525	95530	95535	95540	95545	95550	95554	95559	95564
03	95569	95574	95578	95583	95588	95593	95598	95602	95607	95612
04	95617	95622	95626	95631	95636	95641	95646	95650	95655	95660
05	95665	95670	95674	95679	95684	95689	95694	95698	95703	95708
06	95713	95718	55722	95727	95732	95737	95742	95746	95751	95756
07	95761	95766	95770	95775	95780	95785	95789	95794	95799	95804
08	95809	95813	95818	95823	95828	95832	95837	95842	95847	95852
09	95856	95861	95866	95871	95875	95880	95885	95890	95895	95899
910	2.95904	2.95909	2.95914	2.95918	2.95923	2.95928	2.95933	2.95938	2.95942	2.95947
11	95952	95957	95961	95966	95971	95976	95980	95985	95990	95995
12	95999	96004	96009	96014	96019	96023	96028	96033	96038	96042
13	96047	96052	96057	96061	96066	96071	96076	96080	96085	96090
14	96095	96099	96104	96109	96114	96118	96123	96128	96133	96137
15	96142	96147	96152	96156	96161	96166	96171	96175	96180	96185
16	96190	96194	96199	96204	96209	96213	96218	96223	96227	96232
17	96237	96242	96246	96251	96256	96261	96265	96270	96275	96280
18	96284	96289	96294	96298	96303	96308	96313	96317	96322	96327
19	96332	96336	96341	96346	96350	96355	96360	96365	96369	96374
920	2.96379	2.96384	2.96388	2.96393	2.96398	2.96402	2.96407	2.96412	2.96417	2.96421
21	96426	96431	96435	96440	96445	96450	96454	96459	96464	96468
22	96473	96478	96483	96487	96492	96497	96501	96506	96511	96515
23	96520	96525	96530	96534	96539	96544	96548	96553	96558	96562
24	96567	96572	96577	96581	96586	96591	96595	96600	96605	96609
25	96614	96619	96624	96628	96633	96638	96642	96647	96652	96656
26	96661	96666	96670	96675	96680	96685	96689	96694	96699	96703
27	96708	96713	96717	96722	96727	96731	96736	96741	96745	96750
28	96755	96759	96764	96769	96774	96778	96783	96788	96792	96797
29	96802	96806	96811	96816	96820	96825	96830	96834	96839	96844
930	2.96848	2.96853	2.96858	2.96862	2.96867	2.96872	2.96876	2.96881	2.96886	2.96890
31	96895	96900	96904	96909	96914	96918	96923	96928	96932	96937
32	96942	96946	96951	96956	96960	96965	96970	96974	96979	96984
33	96988	96993	96997	97002	97007	97011	97016	97021	97025	97030
34	97035	97039	97044	97049	97053	97058	97063	97067	97072	97077
35	97081	97086	97090	97095	97100	97104	97109	97114	97118	97123
36	97128	97132	97137	97142	97146	97151	97155	97160	97165	97169
37	97174	97179	97183	97188	97192	97197	97202	97206	97211	97216
38	97220	97225	97230	97234	97239	97243	97248	97253	97257	97262
39	97267	97271	97276	97280	97285	97290	97294	97299	97304	97308

TABLE IV.

A Table of Logarithms from 1 to 10,000.

Nº	0	1	2	3	4	5	6	7	8	9
940	2.97313	2.97317	2.97322	297327	2.97331	2.97336	2.97340	2.97345	2.97350	2.97354
41	97359	97364	97368	97373	97377	97382	97387	97391	97396	97400
42	97405	97410	97414	97419	97424	97428	97433	97437	97442	97447
43	97451	97456	97460	97465	97470	97474	97479	97483	97488	97493
44	97497	97502	97506	97511	97516	97520	97525	97529	97534	97539
45	97543	97548	97552	97557	97562	97566	97571	97575	97580	97585
46	97589	97594	97598	97603	97607	97612	97617	97621	97626	97630
47	97635	97640	97644	97649	97653	97658	97663	97667	97672	97676
48	97681	97685	97690	97695	97699	97704	97708	97713	97717	97722
49	97727	97731	97736	97740	97745	97749	97754	97759	97763	97768
950	2.97772	2.97777	2.97782	2.97786	2.97791	2.97795	2.97800	2.97804	2.97809	2.97813
51	97818	97823	97827	97832	97836	97841	97845	97850	97855	97859
52	97864	97868	97873	97877	97882	97886	97891	97896	97900	97905
53	97909	97914	97918	97923	97928	97932	97937	97941	97946	97950
54	97955	97959	97964	97968	97973	97978	97982	97987	97991	97996
55	98000	98005	98009	98014	98019	98023	98028	98032	98037	98041
56	98046	98050	98055	98059	98064	98068	98073	98078	98082	98087
57	98091	98096	98100	98105	98109	98114	98118	98123	98127	98132
58	98137	98141	98146	98150	98155	98159	98164	98168	98173	98177
59	98182	98186	98191	98195	98200	98204	98209	98214	98218	98223
960	2.98227	2.98232	2.98236	2.98241	2.98245	2.98250	2.98254	2.98259	2.98263	2.98268
61	98272	98277	98281	98286	98290	98295	98299	98304	98308	98313
62	98318	98322	98327	98331	98336	98340	98345	98349	98354	98358
63	98363	98367	98372	98376	98381	98385	98390	98394	98399	98403
64	98408	98412	98417	98421	98426	98430	98435	98439	98444	98448
65	98453	98457	98462	98466	98471	98475	98480	98484	98489	98493
66	98498	98502	98507	98511	98516	98520	98525	98529	98534	98538
67	98543	98547	98552	98556	98561	98565	98570	98574	98579	98583
68	98588	98592	98597	98601	98605	98610	98614	98619	98623	98628
69	98632	98637	98641	98646	98650	98655	98659	98664	98668	98673
970	2.98677	2.98682	2.98686	2.98691	2.98695	2.98700	2.98704	2.98709	2.98713	2.98717
71	98722	98726	98731	98735	98740	98744	98749	98753	98758	98762
72	98767	98771	98776	98780	98784	98789	98793	98798	98802	98807
73	98811	98816	98820	98825	98829	98834	98838	98843	98847	98851
74	98856	98860	98865	98869	98874	98878	98883	98887	98892	98896
75	98900	98905	98909	98914	98918	98923	98927	98932	98936	98941
76	98945	98949	98954	98958	98963	98967	98972	98976	98981	98985
77	98989	98994	98998	99003	99007	99012	99016	99021	99025	99029
78	99034	99038	99043	99047	99052	99056	99061	99065	99069	99074
79	99078	99083	99087	99092	99096	99100	99105	99109	99114	99118
980	2.99123	2.99127	2.99131	2.99136	2.99140	2.99145	2.99149	2.99154	2.99158	2.99162
81	99167	99171	99176	99180	99185	99189	99193	99198	99202	99207
82	99211	99216	99220	99224	99229	99233	99238	99242	99247	99251
83	99255	99260	99264	99269	99273	99277	99282	99286	99291	99295
84	99300	99304	99308	99313	99317	99322	99326	99330	99335	99339
85	99344	99348	99352	99357	99361	99366	99370	99374	99379	99383
86	99388	99392	99396	99401	99405	99410	99414	99419	99423	99427
87	99432	99436	99441	99445	99449	99454	99458	99463	99467	99471
88	99476	99480	99484	99489	99493	99498	99502	99506	99511	99515
89	99520	99524	99528	99533	99537	99542	99546	99550	99555	99559
990	2.99564	2.99568	.99572	2.99577	2.99581	2.99585	2.99590	2.99594	2.99599	2.99603
91	99607	99612	99616	99621	99625	99629	99634	99638	99642	99647
92	99651	99656	99660	99664	99669	99673	99677	99682	99686	99691
93	99695	99699	99704	99708	99712	99717	99721	99726	99730	99734
94	99739	99743	99747	99752	99756	99760	99765	99769	99774	99778
95	99782	99787	99791	99795	99800	99804	99808	99813	99817	99822
96	99826	99830	99835	99839	99843	99848	99852	99856	99861	99865
97	99870	99874	99878	99883	99887	99891	99896	99900	99904	99909
98	99913	99917	99922	99926	99930	99935	99939	99944	99948	99952
99	99957	99961	99965	99970	99974	99978	99983	99987	99991	99996

Table V. Of artificial Sines, Tangents, and Secants. 0 Degs.

M.	Sine.	Co-fine.	Tangent.	Co-tang.	Secant.	Co-fecant.	
0	00.00000	10.00000	00.00000	Infinite.	10.00000	Infinite.	60
1	6.46373	00000	6.46373	13.53627	10.00000	13.53627	59
2	76476	00000	76476	23524	00000	23524	58
3	94085	00000	94085	05915	00000	05915	57
4	7.06579	00000	7.06579	12.93421	00000	12.93421	56
5	16270	00000	16270	83730	00000	83730	55
6	24188	00000	24188	75812	00000	75812	54
7	30882	00000	30882	69118	00000	69118	53
8	36682	00000	36682	63318	00000	63318	52
9	41797	00000	41797	58203	00000	58203	51
10	46373	00000	46373	53627	00000	53627	50
11	7.50512	10.00000	7.50512	12.49488	10.00000	12.49488	49
12	54291	00000	54291	45709	00000	45709	48
13	57767	00000	57767	42233	00000	42233	47
14	60985	00000	60986	39014	00000	39015	46
15	63982	00000	63982	36018	00000	36018	45
16	66784	9.99999	66785	33215	00001	33216	44
17	69417	99999	69418	30582	00001	30583	43
18	71900	99999	71900	28100	00001	28100	42
19	74248	99999	74248	25752	00001	25752	41
20	76475	99999	76476	23524	00001	23525	40
21	7.78594	9.99999	7.78595	12.21405	10.00001	12.21406	39
22	80615	99999	80615	19385	00001	19385	38
23	82545	99999	82546	17454	00001	17455	37
24	84393	99999	84394	15606	00001	15607	36
25	86166	99999	86167	13833	00001	13834	35
26	87870	99999	87871	12129	00001	12130	34
27	89509	99999	89510	10490	00001	10491	33
28	91088	99999	91089	08911	00001	08912	32
29	92612	99999	92613	07387	00001	07388	31
30	94084	99998	94086	05914	00002	05915	30
31	7.95508	9.99998	7.95510	12.04490	10.00002	12.04492	29
32	96887	99998	96889	03111	00002	03113	28
33	98223	99998	98225	01775	00002	01777	27
34	99520	99998	99522	00478	00002	00480	26
35	8.00779	99998	8.00781	11.99219	00002	11.99221	25
36	02002	99998	02004	97996	00002	97998	24
37	03192	99997	03194	96805	00003	96808	23
38	04350	99997	04353	95647	00003	95650	22
39	05478	99997	05481	94519	00003	94522	21
40	06578	99997	06581	93419	00003	93422	20
41	8.07650	9.99997	8.07653	11.92347	10.00003	11.92350	19
42	08696	99997	08700	91300	00003	91304	18
43	09718	99996	09722	90278	00004	90282	17
44	10717	99996	10720	89280	00004	89283	16
45	11693	99996	11696	88304	00004	88307	15
46	12647	99996	12651	87349	00004	87356	14
47	13581	99996	13585	86415	00004	86419	13
48	14495	99996	14500	85500	00004	85505	12
49	15391	99996	15395	84605	00004	84609	11
50	16268	99995	16273	83727	00005	83732	10
51	8.17128	9.99995	8.17133	11.82867	10.00005	11.82872	9
52	17971	99995	17976	82024	00005	82029	8
53	18799	99995	18804	81196	00005	81202	7
54	19610	99995	19616	80384	00005	80390	6
55	20407	99994	20413	79587	00006	79593	5
56	21189	99994	21195	78805	00006	78811	4
57	21958	99994	21964	78036	00006	78042	3
58	22713	99994	22720	77280	00006	77287	2
59	23456	99994	23462	76538	00006	76544	1
60	24186	99993	24192	75808	00007	75814	0
	Co-fine.	Sine.	Co-tang.	Tangent.	Co-fecant.	Secant.	M.

89 Degrees.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	8.24186	9.99993	8.24192	11.75808	10.00007	11.75814	60
1	24903	99993	24910	75090	00007	75097	59
2	25609	99993	25616	74384	00007	74391	58
3	26304	99993	26312	73688	00007	73696	57
4	26988	96663	26996	73004	00007	73012	56
5	27661	99992	27669	72331	00008	72339	55
6	28324	96992	28332	71666	00008	71676	54
7	28977	99992	28986	71014	00008	71023	53
8	29621	99992	29629	70371	00008	70379	52
9	30255	99991	30263	69737	00009	69745	51
10	8.30879	9.99991	8.30888	11.69112	10.00009	11.69121	50
11	31495	99991	31505	68495	00009	68505	49
12	32103	99991	32112	67888	00009	67897	48
13	32702	99990	32711	67289	00010	67298	47
14	33292	99990	33302	66698	00010	66708	46
15	33875	99990	33886	66114	00010	66125	45
16	34450	99989	34461	65539	00011	65550	44
17	35018	99989	35029	64971	00011	64982	43
18	35578	99989	35590	64410	00011	64422	42
19	36132	99989	36143	63857	00011	63868	41
20	8.36678	9.99988	8.36689	11.63311	10.00012	11.63322	40
21	37217	99988	37229	62771	00012	62783	39
22	37750	99988	37762	62238	00012	62250	38
23	38276	99987	38289	61711	00013	61724	37
24	38796	99987	38809	61191	00013	61204	36
25	39310	99987	39323	60677	00013	60690	35
26	39818	99986	39832	60168	00014	60182	34
27	40320	99986	40334	59666	00014	59680	33
28	40816	99986	40830	59170	00014	59184	32
29	41307	99985	41321	58679	00015	58693	31
30	8.41792	9.99985	8.41807	11.58193	10.00015	11.58208	30
31	42272	99985	42287	57713	00015	57728	29
32	42746	99984	42762	57238	00016	57254	28
33	43216	99984	43232	56768	00016	56784	27
34	43680	99984	43696	56304	00016	56320	26
35	44139	99983	44156	55844	00017	55861	25
36	44594	99983	44611	55389	00017	55406	24
37	45044	99983	45061	54939	00017	54956	23
38	45489	99982	45507	54493	00018	54510	22
39	45930	99982	45948	54052	00018	54070	21
40	8.46367	9.99982	8.46385	11.53615	10.00018	11.53633	20
41	46799	99981	46817	53183	00019	53201	19
42	47226	99981	47245	52755	00019	52774	18
43	47650	99981	47669	52331	00019	52350	17
44	48069	99980	48089	51911	00020	51931	16
45	48485	99980	48505	51495	00020	51515	15
46	48896	99979	48917	51083	00021	51104	14
47	49304	99979	49325	50675	00021	50696	13
48	49708	99979	49729	50271	00021	50292	12
49	50108	99978	50130	49870	00022	49892	11
50	8.50505	9.99978	8.50527	11.49473	10.00022	11.49495	10
51	50897	99977	50920	49080	00023	49103	9
52	51287	99977	51310	48690	00023	48713	8
53	51673	99977	51696	48304	00023	48327	7
54	52055	99976	52079	47921	00024	47945	6
55	52434	99976	52459	47541	00024	47566	5
56	52810	99975	52835	47165	00025	47190	4
57	53183	99975	53208	46792	00025	46817	3
58	53552	99974	53578	46422	00026	46448	2
59	53919	99974	53945	46055	00026	46081	1
60	54282	99974	54308	45692	00026	45718	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	8.54282	9.99974	8.54308	11.45692	10.00026	11.45718	60
1	54642	99973	54669	45331	00027	45358	59
2	54999	99973	55027	44973	00027	45001	58
3	55354	99972	55382	44618	00028	44646	57
4	55705	99972	55734	44266	00028	44295	56
5	56054	99971	56083	43917	00029	43946	55
6	56400	99971	56429	43571	00029	43600	54
7	56743	99970	56773	43227	00030	43257	53
8	57084	99970	57114	42886	00030	42916	52
9	57421	99969	57452	42548	00031	42579	51
10	8.57757	9.99969	8.57788	11.42212	10.00031	11.42243	50
11	58089	99968	58121	41879	00032	41911	49
12	58419	99968	58451	41549	00032	41581	48
13	58747	99968	58779	41221	00032	41253	47
14	59072	99967	59105	40895	00033	40928	46
15	59395	99967	59428	40572	00033	40605	45
16	59715	99966	59749	40251	00034	40285	44
17	60033	99966	60068	39932	00034	39967	43
18	60349	99965	60384	39616	00035	39651	42
19	60662	99965	60698	39302	00035	39338	41
20	8.60973	9.99964	8.61009	11.38991	10.00036	11.39027	40
21	61282	99964	61319	38681	00036	38718	39
22	61589	99963	61626	38374	00037	38411	38
23	61894	99962	61931	38069	00038	38106	37
24	62196	99962	62234	37766	00038	37804	36
25	62497	99961	62535	37465	00039	37503	35
26	62795	99961	62834	37166	00039	37205	34
27	63091	99960	63131	36869	00040	36909	33
28	63385	99960	63426	36574	00040	36615	32
29	63678	99959	63718	36282	00041	36322	31
30	8.63968	9.99959	8.64009	11.35991	10.00041	11.36032	30
31	64256	99958	64298	35702	00042	35744	29
32	64543	99958	64585	35415	00042	35457	28
33	64827	99957	64870	35130	00043	35173	27
34	65110	99956	65154	34846	00044	34890	26
35	65391	99956	65435	34565	00044	34609	25
36	65670	99955	65715	34285	00045	34330	24
37	65947	99955	65993	34007	00045	34053	23
38	66223	99954	66269	33731	00046	33777	22
39	66497	99954	66543	33457	00046	33503	21
40	8.66769	9.99953	8.66816	11.33184	10.00047	11.33231	20
41	67039	99932	67087	32913	00048	32961	19
42	67308	99952	67356	32644	00048	32692	18
43	67575	99951	67624	32376	00049	32425	17
44	67841	99951	67890	32110	00049	32159	16
45	68104	99950	68154	31846	00050	31896	15
46	68367	99949	68417	31583	00051	31633	14
47	68627	99949	68678	31322	00051	31373	13
48	68886	99948	68938	31062	00052	31114	12
49	69144	99948	69196	30804	00052	30856	11
50	8.69400	9.99947	8.69453	11.30547	10.00053	11.30600	10
51	69654	99946	69708	30292	00054	30346	9
52	69907	99946	69962	30038	00054	30093	8
53	70159	99945	70214	29786	00055	29841	7
54	70409	99944	70465	29535	00056	29591	6
55	70658	99944	70714	29286	00056	29342	5
56	70905	99943	70962	29038	00057	29095	4
57	71151	99942	71208	28792	00058	28849	3
58	71395	99942	71453	28547	00058	28605	2
59	71638	99941	71697	28303	00059	28362	1
60	71880	99940	71940	28060	00059	28120	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.

M.	Sine.	Co-fine.	Tangent.	Co-tang.	Secant.	Co-fecant	
0	8.71880	9.99940	8.71940	11.28060	10.00060	11.28120	60
1	72120	99940	72181	27819	00060	27880	59
2	72360	99939	72420	27580	00061	27640	58
3	72597	99938	72659	27341	00062	27403	57
4	72834	99938	72896	27104	00062	27166	56
5	73069	99937	73132	26868	00063	26931	55
6	73303	99936	73366	26634	00064	26697	54
7	73535	99936	73600	26400	00064	26465	53
8	73767	99935	73832	26168	00065	26233	52
9	73997	99934	74063	25937	00066	26003	51
10	8.74226	9.99934	8.74292	11.25708	10.00066	11.25774	50
11	74454	99933	74521	25479	00067	25546	49
12	74680	99932	74748	25252	00068	25320	48
13	74906	99932	74974	25026	00068	25094	47
14	75130	99931	75199	24801	00069	24870	46
15	75353	99930	75423	24577	00070	24647	45
16	75575	99929	75645	24355	00071	24425	44
17	75796	99929	75867	24133	00071	24204	43
18	76015	99928	76087	23913	00072	23985	42
19	76234	99927	76306	23694	00073	23766	41
20	8.76451	9.99927	8.76525	11.23475	10.00073	11.23549	40
21	76667	99926	76742	23258	00074	23332	39
22	76883	99925	76958	23042	00075	23117	38
23	77097	99924	77173	22827	00076	22903	37
24	77310	99924	77387	22613	00076	22690	36
25	77522	99923	77600	22400	00077	22478	35
26	77733	99922	77811	22189	00078	22267	34
27	77943	99921	78022	21978	00079	22057	33
28	78152	99921	78232	21768	00079	21848	32
29	78361	99920	78441	21559	00080	21639	31
30	8.78568	9.99919	8.78649	11.21351	10.00081	11.21432	30
31	78774	99918	78855	21145	00082	21226	29
32	78979	99917	79061	20939	00083	21021	28
33	79183	99917	79266	20734	00083	20817	27
34	79386	99916	79470	20530	00084	20614	26
35	79588	99915	79673	20327	00085	20412	25
36	79789	99914	79875	20125	00086	20211	24
37	79990	99913	80076	19924	00087	20010	23
38	80189	99913	80277	19723	00087	19811	22
39	80388	99912	80476	19524	00088	19612	21
40	8.80585	9.99911	8.80674	11.19326	10.00089	11.19415	20
41	80782	99910	80872	19128	00090	19218	19
42	80978	99909	81068	18932	00091	19022	18
43	81173	99909	81264	18736	00091	18827	17
44	81367	99908	81459	18541	00092	18633	16
45	81560	99907	81653	18347	00093	18440	15
46	81752	99906	81846	18154	00094	18248	14
47	81944	99905	82038	17962	00095	18056	13
48	82134	99904	82230	17770	00096	17866	12
49	82324	99904	82420	17580	00096	17676	11
50	8.82513	9.99903	8.82610	11.17390	10.00097	11.17487	10
51	82701	99902	82799	17201	00098	17299	9
52	82888	99901	82987	17013	00099	17112	8
53	83073	99900	83175	16825	00100	16925	7
54	83261	99899	83361	16639	00101	16739	6
55	83446	99898	83547	16453	00102	16554	5
56	83630	99898	83732	16268	00102	16370	4
57	83813	99897	83916	16084	00103	16187	3
58	83996	99896	84100	15900	00104	16004	2
59	84177	99895	84282	15718	00105	15823	1
60	84358	99894	84464	15536	00106	15642	0
	Co-fine.	Sine.	Co-tang.	Tangent.	Co-fecant	Secant.	M.

M.	Sine.	Co sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	8.84358	9.99894	8.84464	11.15536	10.00106	11.15642	60
1	84539	99893	84646	15354	00107	15461	59
2	84718	99892	84826	15174	00108	15282	58
3	84897	99891	85006	14994	00109	15103	57
4	85075	99891	85185	14815	00109	14925	56
5	85252	99890	85363	14637	00110	14748	55
6	85429	99889	85540	14460	00111	14571	54
7	85605	99888	85717	14283	00112	14395	53
8	85780	99887	85893	14107	00113	14220	52
9	85955	99886	86069	13931	00114	14045	51
10	8.86128	9.99885	8.86243	11.13757	10.00115	11.13872	50
11	86301	99884	86417	13583	00116	13699	49
12	86474	99883	86591	13409	00117	13526	48
13	86645	99882	86763	13237	00118	13355	47
14	86816	99881	86935	13065	00119	13184	46
15	86987	99880	87106	12894	00120	13013	45
1	87156	99879	87277	12723	00121	12844	44
16	87325	99879	87447	12553	00121	12675	43
17	87494	99878	87616	12384	00122	12506	42
18	87661	99877	87785	12215	00123	12339	41
20	8.87829	9.99876	8.87953	11.12047	10.00124	11.12171	40
21	87995	99875	88120	11880	00125	12005	39
22	88161	99874	88287	11713	00126	11839	38
23	88326	99873	88453	11547	00127	11674	37
24	88490	99872	88618	11382	00128	11510	36
25	88654	99871	88783	11217	00129	11346	35
26	88817	99870	88948	11052	00130	11183	34
27	88980	99869	89111	10889	00131	11020	33
28	89142	99868	89274	10726	00132	10858	32
29	89304	99867	89437	10563	00133	10696	31
30	8.89464	9.99866	8.89598	11.10402	10.00134	11.10536	30
31	89625	99865	89760	10240	00135	10375	29
32	89784	99864	89920	10080	00136	10216	28
33	89943	99863	90080	09920	00137	10057	27
34	90102	99862	90240	09760	00138	09898	26
35	90260	99861	90399	09601	00139	09740	25
36	90417	99860	90557	09443	00140	09583	24
37	90574	99859	90715	09285	00141	09426	23
38	90730	99858	90872	09128	00142	09270	22
39	90885	99857	91029	08971	00143	09115	21
40	8.91040	9.99856	8.91185	11.08815	10.00144	11.08960	20
41	91195	99855	91340	08660	00145	08805	19
42	91349	99854	91495	08505	00146	08651	18
43	91502	99853	91650	08350	00147	08498	17
44	91655	99852	91803	08197	00148	08345	16
45	91807	99851	91957	08043	00149	08193	15
46	91959	99850	92110	07890	00150	08041	14
47	92110	99848	92262	07738	00152	07890	13
48	92261	99847	92414	07586	00153	07739	12
49	92411	99846	92565	07435	00154	07589	11
50	8.92561	9.99845	8.92716	11.07284	10.00155	11.07439	10
51	92710	99844	92866	07134	00156	07290	9
52	92859	99843	93016	06984	00157	07141	8
53	93007	99842	93165	06835	00158	06993	7
54	93154	99841	93313	06687	00159	06846	6
55	93301	99840	93462	06538	00160	06699	5
56	93448	99839	93609	06391	00161	06552	4
57	93594	99838	93756	06244	00162	06406	3
58	93740	99837	93903	06097	00163	06260	2
59	93885	99836	94049	05951	00164	06115	1
60	94030	99834	94195	05805	00166	05970	0
	Co-sine.	Sine.	Co-tang.	Co-secant.	Co-secant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant	
0	8.94030	9.99834	8.94195	11.05805	10.00166	11.05970	60
1	94174	99833	94340	05660	00167	05826	59
2	94317	99832	94485	05515	00168	05683	58
3	94461	99831	94630	05370	00169	05539	57
4	94603	99830	94773	05227	00170	05397	56
5	94746	99829	94917	05083	00171	05254	55
6	94887	99828	95060	04940	00172	05113	54
7	95029	99827	95202	04798	00173	04971	53
8	95170	99825	95344	04656	00175	04830	52
9	95310	99824	95486	04514	00176	04690	51
10	8.95450	9.99823	8.95627	11.04373	10.00177	11.04550	50
11	95589	99822	95767	04233	00178	04411	49
12	95728	99821	95908	04092	00179	04272	48
13	95867	99820	96047	03953	00180	04133	47
14	96005	99819	96187	03813	00181	03995	46
15	96143	99817	96325	03675	00183	03857	45
16	96280	99816	96464	03536	00184	03720	44
17	96417	99815	96602	03398	00185	03583	43
18	96553	99814	96739	03261	00186	03447	42
19	96689	99813	96877	03123	00187	03311	41
20	8.96825	9.99812	8.97013	11.02987	10.00188	11.03175	40
21	96960	99810	97150	02850	00190	03040	39
22	97095	99809	97285	02715	00191	02905	38
23	97229	99808	97421	02579	00192	02771	37
24	97363	99807	97556	02444	00193	02637	36
25	97496	99806	97691	02309	00194	02504	35
26	97629	99804	97825	02175	00196	02371	34
27	97762	99803	97959	02041	00197	02238	33
28	97894	99802	98092	01908	00198	02106	32
29	98026	99801	98225	01775	00199	01974	31
30	8.98157	9.99800	8.98358	11.01642	10.00200	11.01843	30
31	98288	99798	98490	01510	00202	01712	29
32	98419	99797	98622	01378	00203	01581	28
33	98549	99796	98753	01247	00204	01451	27
34	98679	99795	98884	01116	00205	01321	26
35	98808	99793	99015	00985	00207	01192	25
36	98937	99792	99145	00855	00208	01063	24
37	99066	99791	99275	00725	00209	00934	23
38	99194	99790	99405	00595	00210	00806	22
39	99322	99788	99534	00466	00212	00678	21
40	8.99450	9.99787	8.99662	11.00338	10.00213	11.00550	20
41	99577	99786	99791	00209	00214	00423	19
42	99704	99785	99919	00081	00215	00296	18
43	99830	99783	9.00046	10.99954	00217	00170	17
44	99956	99782	00174	99826	00218	00044	16
45	9.00082	99781	00301	99699	00219	10.99918	15
46	00207	99780	00427	99573	00220	99793	14
47	00332	99778	00553	99447	00222	99668	13
48	00456	99777	00679	99321	00223	99544	12
49	00581	99776	00805	99195	00224	99419	11
50	9.00704	9.99775	9.00930	10.99070	10.00225	10.99296	10
51	00828	99773	01055	98945	00227	99172	9
52	00951	99772	01179	98821	00228	99049	8
53	01074	99771	01303	98697	00229	98926	7
54	01196	99769	01427	98573	00231	98804	6
55	01318	99768	01550	98450	00232	98682	5
56	01440	99767	01673	98327	00233	98560	4
57	01561	99765	01796	98204	00235	98439	3
58	01682	99764	01918	98082	00236	98318	2
59	01803	99763	02040	97960	00237	98197	1
60	01923	99761	02162	97838	00239	98077	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co secant.	Secant.	M.

M	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.01923	9.99761	9.02162	10.97838	10.00239	10.98077	60
1	02043	99760	02283	97717	00240	97957	59
2	02163	99759	02404	97596	00241	97837	58
3	02283	99757	02525	97475	00243	97717	57
4	02402	99756	02645	97355	00244	97598	56
5	02520	99755	02766	97234	00245	97480	55
6	02639	99753	02885	97115	00247	97361	54
7	02757	99752	03005	96995	00248	97243	53
8	02874	99751	03124	96876	00249	97126	52
9	02992	99749	03242	96758	00251	97008	51
10	9.03109	9.99748	9.03361	10.96639	10.00252	10.96891	50
11	03226	99747	03479	96521	00253	96774	49
12	03342	99745	03597	96403	00255	96658	48
13	03458	99744	03714	96286	00256	96542	47
14	03574	99742	03832	96168	00258	96426	46
15	03690	99741	03948	96052	00259	96310	45
16	03805	99740	04065	95935	00260	96195	44
17	03920	99738	04181	95819	00262	96080	43
18	04034	99737	04297	95703	00263	95966	42
19	04149	99736	04413	95587	00264	95851	41
20	9.04262	9.99734	9.04528	10.95472	10.00266	10.95738	40
21	04376	99733	04643	95357	00267	95624	39
22	04490	99731	04758	95242	00269	95510	38
23	04603	99730	04873	95127	00270	95397	37
24	04715	99728	04987	95013	00272	95285	36
25	04828	99727	05101	94899	00273	95172	35
26	04940	99726	05214	94786	00274	95060	34
27	05052	99724	05328	94672	00276	94948	33
28	05164	99723	05441	94559	00277	94836	32
29	05275	99721	05553	94447	00279	94725	31
30	9.05386	9.99720	9.05666	10.94334	10.00280	10.94614	30
31	05497	99718	05778	94222	00282	94503	29
32	05607	99717	05890	94110	00283	94393	28
33	05717	99716	06002	93998	00284	94283	27
34	05827	99714	06113	93887	00286	94173	26
35	05937	99713	06224	93776	00287	94063	25
36	06046	99711	06335	93665	00289	93954	24
37	06155	99710	06445	93555	00290	93845	23
38	06264	99708	06556	93444	00292	93736	22
39	06372	99707	06666	93334	00293	93628	21
40	9.06481	9.99705	9.06775	10.93225	10.00295	10.93519	20
41	06589	99704	06885	93115	00296	93411	19
42	06696	99702	06994	93006	00298	93304	18
43	06804	99701	07103	92897	00299	93196	17
44	06911	99699	07211	92789	00301	93089	16
45	07018	99698	07320	92680	00302	92982	15
46	07124	99696	07428	92572	00304	92876	14
47	07231	99695	07536	92464	00305	92769	13
48	07337	99693	07643	92357	00307	92663	12
49	07442	99692	07751	92249	00308	92558	11
50	9.07548	9.99690	9.07858	10.92142	10.00310	10.92452	10
51	07653	99689	07964	92036	00311	92347	9
52	07758	99687	08071	91929	00313	92242	8
53	07863	99686	08177	91823	00314	92137	7
54	07968	99684	08283	91717	00316	92032	6
55	08072	99683	08389	91611	00317	91928	5
56	08176	99681	08495	91505	00319	91824	4
57	08280	99680	08600	91400	00320	91720	3
58	08383	99678	08705	91295	00322	91617	2
59	08486	99677	08810	91190	00323	91514	1
60	08589	99675	08914	91086	00325	91411	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

A Table of Logarithms from 1 to 10,000.

N°	0	1	2	3	4	5	6	7	8	9
820	2.91381	2.91387	2.91392	2.91397	2.91403	2.91408	2.91413	2.91418	2.91424	2.91429
21	91434	91440	91445	91450	91455	91461	91466	91471	91477	91482
22	91487	91492	91498	91503	91508	91514	91519	91524	91529	91535
23	91540	91545	91551	91556	91561	91566	91572	91577	91582	91587
24	91593	91598	91603	91609	91614	91619	91624	91630	91635	91640
25	91645	91651	91656	91661	91666	91672	91677	91682	91687	91693
26	91698	91703	91709	91714	91719	91724	91730	91735	91740	91745
27	91751	91756	91761	91766	91772	91777	91782	91787	91793	91798
28	91803	91808	91814	91819	91824	91829	91834	91840	91845	91850
29	91855	91861	91866	91871	91876	91882	91887	91892	91897	91903
830	2.91908	2.91913	2.91918	2.91924	2.91929	2.91934	2.91939	2.91944	2.91950	2.91955
31	91960	91965	91971	91976	91981	91986	91991	91997	92002	92007
32	92012	92018	92023	92028	92033	92038	92044	92049	92054	92059
33	92065	92070	92075	92080	92085	92091	92096	92101	92106	92111
34	92117	92122	92127	92132	92137	92143	92148	92153	92158	92163
35	92169	92174	92179	92184	92189	92195	92200	92205	92210	92215
36	92221	92226	92231	92236	92241	92247	92252	92257	92262	92267
37	92273	92278	92283	92288	92293	92298	92304	92309	92314	92319
38	92324	92330	92335	92340	92345	92350	92355	92361	92366	92371
39	92376	92381	92387	92392	92397	92402	92407	92412	92418	92423
840	2.92428	2.92433	2.92438	2.92443	2.92449	2.92454	2.92459	2.92464	2.92469	2.92474
41	92480	92485	92490	92495	92500	92505	92511	92516	92521	92526
42	92531	92536	92542	92547	92552	92557	92562	92567	92572	92578
43	92583	92588	92593	92598	92603	92609	92614	92619	92624	92629
44	92634	92639	92645	92650	92655	92660	92665	92670	92675	92681
45	92686	92691	92696	92701	92706	92711	92716	92722	92727	92732
46	92737	92742	92747	92752	92758	92763	92768	92773	92778	92783
47	92788	92793	92799	92804	92809	92814	92819	92824	92829	92834
48	92840	92845	92850	92855	92860	92865	92870	92875	92881	92886
49	92891	92896	92901	92906	92911	92916	92921	92927	92932	92937
850	2.92942	2.92947	2.92952	2.92957	2.92962	2.92967	2.92973	2.92978	2.92983	2.92988
51	92993	92998	93003	93008	93013	93018	93024	93029	93034	93039
52	93044	93049	93054	93059	93064	93069	93075	93080	93085	93090
53	93095	93100	93105	93110	93115	93120	93125	93131	93136	93141
54	93146	93151	93156	93161	93166	93171	93176	93181	93186	93192
55	93197	93202	93207	93212	93217	93222	93227	93232	93237	93242
56	93247	93252	93258	93263	93268	93273	93278	93283	93288	93293
57	93298	93303	93308	93313	93318	93323	93328	93334	93339	93344
58	93349	93354	93359	93364	93369	93374	93379	93384	93389	93394
59	93399	93404	93409	93414	93420	93425	93430	93435	93440	93445
860	2.93450	2.93455	2.93460	2.93465	2.93470	2.93475	2.93480	2.93485	2.93490	2.93495
61	93500	93505	93510	93515	93520	93526	93531	93536	93541	93546
62	93551	93556	93561	93566	93571	93576	93581	93586	93591	93596
63	93601	93606	93611	93616	93621	93626	93631	93636	93641	93646
64	93651	93656	93661	93666	93671	93676	93682	93687	93692	93697
65	93702	93707	93712	93717	93722	93727	93732	93737	93742	93747
66	93752	93757	93762	93767	93772	93777	93782	93787	93792	93797
67	93802	93807	93812	93817	93822	93827	93832	93837	93842	93847
68	93852	93857	93862	93867	93872	93877	93882	93887	93892	93897
69	93902	93907	93912	93917	93922	93927	93932	93937	93942	93947
870	2.93952	2.93957	2.93962	2.93967	2.93972	2.93977	2.93982	2.93987	2.93992	2.93997
71	94002	94007	94012	94017	94022	94027	94032	94037	94042	94047
72	94052	94057	94062	94067	94072	94077	94082	94086	94091	94096
73	94101	94106	94111	94116	94121	94126	94131	94136	94141	94146
74	94151	94156	94161	94166	94171	94176	94181	94186	94191	94196
75	94201	94206	94211	94216	94221	94226	94231	94236	94240	94246
76	94250	94255	94260	94265	94270	94275	94280	94285	94290	94295
77	94300	94305	94310	94315	94320	94325	94330	94335	94340	94345
78	94349	94354	94359	94364	94369	94374	94379	94384	94389	94394
79	94399	94404	94409	94414	94419	94424	94429	94433	94438	94443

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.14356	9.99575	9.14780	10.85220	10.00425	10.85644	60
1	14445	99574	14872	85128	00426	85555	59
2	14535	99572	14963	85037	00428	85465	58
3	14624	99570	15054	84946	00430	85376	57
4	14714	99568	15145	84855	00432	85286	56
5	14803	99566	15236	84764	00434	85197	55
6	14891	99565	15327	84673	00435	85109	54
7	14980	99563	15417	84583	00437	85020	53
8	15069	99561	15508	84492	00439	84931	52
9	15157	99559	15598	84402	00441	84843	51
10	9.15245	9.99557	9.15688	10.84312	10.00443	10.84755	50
11	15333	99556	15777	84223	00444	84667	49
12	15421	99554	15867	84133	00446	84579	48
13	15508	99552	15956	84044	00448	84492	47
14	15596	99550	16046	83954	00450	84404	46
15	15683	99548	16135	83865	00452	84317	45
16	15770	99546	16224	83776	00454	84230	44
17	15857	99545	16312	83688	00455	84143	43
18	15944	99543	16401	83599	00457	84056	42
19	16030	99541	16489	83511	00459	83970	41
20	9.16116	9.99539	9.16577	10.83423	10.00461	10.83884	40
21	16203	99537	16665	83335	00463	83797	39
22	16289	99535	16753	83247	00465	83711	38
23	16374	99533	16841	83159	00467	83626	37
24	16460	99532	16928	83072	00468	83540	36
25	16545	99530	17016	82984	00470	83455	35
26	16631	99528	17103	82897	00472	83369	34
27	16716	99526	17190	82810	00474	83284	33
28	16801	99524	17277	82723	00476	83199	32
29	16886	99522	17363	82637	00478	83114	31
30	9.16970	9.99520	9.17450	10.82550	10.00480	10.83030	30
31	17055	99518	17536	82464	00482	82945	29
32	17139	99517	17622	82378	00483	82861	28
33	17223	99515	17708	82292	00485	82777	27
34	17307	99513	17794	82206	00487	82693	26
35	17391	99511	17880	82120	00489	82609	25
36	17474	99509	17965	82035	00491	82526	24
37	17558	99507	18051	81949	00493	82442	23
38	17641	99505	18136	81864	00495	82359	22
39	17724	99503	18221	81779	00497	82276	21
40	9.17807	9.99501	9.18306	10.81694	10.00499	10.82193	20
41	17890	99499	18391	81609	00501	82110	19
42	17973	99497	18475	81525	00503	82027	18
43	18055	99495	18560	81440	00505	81945	17
44	18137	99494	18644	81356	00506	81863	16
45	18220	99492	18728	81272	00508	81780	15
46	18302	99490	18812	81188	00510	81698	14
47	18383	99488	18896	81104	00512	81617	13
48	18465	99486	18979	81021	00514	81535	12
49	18547	99484	19063	80937	00516	81453	11
50	9.18628	9.99482	9.19146	10.80854	10.00518	10.81372	10
51	18709	99480	19229	80771	00520	81291	9
52	18790	99478	19312	80688	00522	81210	8
53	18871	99476	19395	80605	00524	81129	7
54	18952	99474	19478	80522	00526	81048	6
55	19033	99472	19561	80439	00528	80967	5
56	19113	99470	19643	82357	00530	80887	4
57	19193	99468	19725	80275	00532	80807	3
58	19273	99466	19807	80193	00534	80727	2
59	19353	99464	19889	80111	00536	80647	1
60	19433	99462	19971	80029	00538	80567	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

81 Degrees.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.19433	9.99462	9.19971	10.80029	10.00538	10.80567	60
1	19513	99460	20053	79947	00540	80487	59
2	19592	99458	20134	79866	00542	80408	58
3	19672	99456	20216	79784	00544	80328	57
4	19751	99454	20297	79703	00546	80249	56
5	19830	99452	20378	79622	00548	80170	55
6	19909	99450	20459	79541	00550	80091	54
7	19988	99448	20540	79460	00552	80012	53
8	20067	99446	20621	79379	00554	79933	52
9	20145	99444	20701	79299	00556	79855	51
10	9.20223	9.99442	9.20782	10.79218	10.00558	10.79777	50
11	20302	99440	20862	79138	00560	79698	49
12	20380	99438	20942	79058	00562	79620	48
13	20458	99436	21022	78978	00564	79542	47
14	20535	99434	21102	78898	00566	79465	46
15	20613	99432	21182	78818	00568	79387	45
16	20691	99429	21261	78739	00571	79309	44
17	20768	99427	21341	78659	00573	79232	43
18	20845	99425	21420	78580	00575	79155	42
19	20922	99423	21499	78501	00577	79078	41
20	9.20999	9.99421	9.21578	10.78422	10.00579	10.79001	40
21	21076	99419	21657	78343	00581	78924	39
22	21153	99417	21736	78264	00583	78847	38
23	21229	99415	21814	78186	00585	78771	37
24	21306	99413	21893	78107	00587	78694	36
25	21382	99411	21971	78029	00589	78618	35
26	21458	99409	22049	77951	00591	78542	34
27	21534	99407	22127	77873	00593	78466	33
28	21610	99404	22205	77795	00596	78390	32
29	21685	99402	22283	77717	00598	78315	31
30	9.21761	9.99400	9.22361	10.77639	10.00600	10.78239	30
31	21836	99398	22438	77562	00602	78164	29
32	21912	99396	22516	77484	00604	78088	28
33	21987	99394	22593	77407	00606	78013	27
34	22062	99392	22670	77330	00608	77938	26
35	22137	99390	22747	77253	00610	77863	25
36	22211	99388	22824	77176	00612	77789	24
37	22286	99385	22901	77099	00615	77714	23
38	22361	99383	22977	77023	00617	77639	22
39	22435	99381	23054	76946	00619	77565	21
40	9.22509	9.99379	9.23130	10.76870	10.00621	10.77491	20
41	22583	99377	13206	76794	00623	77417	19
42	22657	99375	23283	76717	00625	77343	18
43	22731	99372	23359	76641	00628	77269	17
44	22805	99370	23435	76565	00630	77195	16
45	22878	99368	23510	76490	00632	77122	15
46	22952	99366	23586	76414	00634	77048	14
47	23025	99364	23661	76339	00636	76975	13
48	23098	99362	23737	76263	00638	76902	12
49	23171	99359	23812	76188	00641	76829	11
50	9.23244	9.99357	9.23887	10.76113	10.00643	10.76756	10
51	23317	99355	23962	76038	00645	76683	9
52	23390	99353	24037	75963	00647	76610	8
53	23462	99351	24112	75888	00649	76538	7
54	23535	99348	24186	75814	00652	76465	6
55	23607	99346	24261	75739	00654	76393	5
56	23679	99344	24335	75665	00656	76321	4
57	23752	99342	24410	75590	00658	76248	3
58	23823	99340	24484	75516	00660	76177	2
59	23895	99337	24558	75442	00663	76105	1
60	23967	99335	24632	75368	00665	76033	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.23967	9.99335	9.24632	10.75368	10.00665	10.76033	60
1	24039	99333	24706	75294	00667	75961	59
2	24110	99331	24779	75221	00669	75890	58
3	24181	99328	24853	75147	00672	75819	57
4	24253	99326	24926	75074	00674	75747	56
5	24324	99324	25000	75000	00676	75676	55
6	24395	99322	25073	74927	00678	75605	54
7	24466	99319	25146	74854	00681	75534	53
8	24536	99317	25219	74781	00683	75464	52
9	24607	99315	25292	74708	00685	75393	51
10	9.24677	9.99313	9.25365	10.74635	10.00687	10.75323	50
11	24748	99310	25437	74563	00690	75252	49
12	24818	99308	25510	74490	00692	75182	48
13	24888	99306	25582	74418	00694	75112	47
14	24958	99304	25655	74345	00696	75042	46
15	25028	99301	25727	74273	00699	74972	45
16	25098	99299	25799	74201	00701	74902	44
17	25168	99297	25871	74129	00703	74832	43
18	25237	99294	25943	74057	00706	74763	42
19	25307	99292	26015	73985	00708	74693	41
20	9.25376	9.99290	9.26086	10.73914	10.00710	10.74624	40
21	25445	99288	26158	73842	00712	74555	39
22	25514	99285	26229	73771	00715	74486	38
23	25583	99283	26301	73699	00717	74417	37
24	25652	99281	26372	73628	00719	74348	36
25	25721	99278	26443	73557	00722	74279	35
26	25790	99276	26514	73486	00724	74210	34
27	25858	99274	26585	73415	00726	74142	33
28	25927	99271	26655	73345	00729	74073	32
29	25995	99269	26726	73274	00731	74005	31
30	9.26063	9.99267	9.26797	10.73203	10.00733	10.73937	30
31	26131	99264	26867	73133	00736	73869	29
32	26199	99262	26937	73063	00738	73801	28
33	26267	99260	27008	72992	00740	73733	27
34	26335	99257	27078	72922	00743	73665	26
35	26403	99255	27148	72852	00745	73597	25
36	26470	99252	27218	72782	00748	73530	24
37	26538	99250	27288	72712	00750	73462	23
38	26605	99248	27357	72643	00752	73395	22
39	26672	99245	27427	72573	00755	73328	21
40	9.26739	9.99243	9.27496	10.72504	10.00757	10.73261	20
41	26806	99241	27566	72434	00759	73194	19
42	26873	99238	27635	72365	00762	73127	18
43	26940	99236	27704	72296	00764	73060	17
44	27007	99233	27773	72227	00767	72993	16
45	27073	99231	27842	72158	00769	72927	15
46	27140	99229	27911	72089	00771	72860	14
47	27206	99226	27980	72020	00774	72794	13
48	27273	99224	28049	71951	00776	72727	12
49	27339	99221	28117	71883	00779	73661	11
50	9.27405	9.99219	9.28186	10.71814	10.00781	10.72595	10
51	27471	99217	28254	71746	00783	72529	9
52	27537	99214	28323	71677	00786	72463	8
53	27602	99212	28391	71609	00788	72398	7
54	27668	99209	28459	71541	00791	72332	6
55	27734	99207	28527	71473	00793	72266	5
56	27799	99204	28595	71405	00796	72201	4
57	27864	99202	28662	71338	00798	72136	3
58	27930	99200	28730	71270	00800	720 0	2
59	27995	99197	28798	71202	00803	72005	1
60	28060	99195	28865	71135	00805	71940	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	8.24186	9.99993	8.24192	11.75808	10.00007	11.75814	60
1	24903	99993	24910	75090	00007	75097	59
2	25609	99993	25616	74384	00007	74391	58
3	26304	99993	26312	73688	00007	73696	57
4	26988	96663	26996	73004	00007	73012	56
5	27661	99992	27669	72331	00008	72339	55
6	28324	96992	28332	71668	00008	71676	54
7	28977	99992	28986	71014	00008	71023	53
8	29621	99992	29629	70371	00008	70379	52
9	30255	99991	30263	69737	00009	69745	51
10	8.30879	9.99991	8.30888	11.69112	10.00009	11.69121	50
11	31495	99991	31505	68495	00009	68505	49
12	32103	99991	32112	67888	00009	67897	48
13	32702	99990	32711	67289	00010	67298	47
14	33292	99990	33302	66698	00010	66708	46
15	33875	99990	33886	66114	00010	66125	45
16	34450	99989	34461	65539	00011	65550	44
17	35018	99989	35029	64971	00011	64982	43
18	35578	99989	35590	64410	00011	64422	42
19	36132	99989	36143	63857	00011	63868	41
20	8.36678	9.99988	8.36689	11.63311	10.00012	11.63322	40
21	37217	99988	37229	62771	00012	62783	39
22	37750	99988	37762	62238	00012	62250	38
23	38276	99987	38289	61711	00013	61724	37
24	38796	99987	38809	61191	00013	61204	36
25	39310	99987	39323	60677	00013	60690	35
26	39818	99986	39832	60168	00014	60182	34
27	40320	99986	40334	59666	00014	59680	33
28	40816	99986	40830	59170	00014	59184	32
29	41307	99985	41321	58679	00015	58693	31
30	8.41792	9.99985	8.41807	11.58193	10.00015	11.58208	30
31	42272	99985	42287	57713	00015	57728	29
32	42746	99984	42762	57238	00016	57254	28
33	43216	99984	43232	56768	00016	56784	27
34	43680	99984	43696	56304	00016	56320	26
35	44139	99983	44156	55844	00017	55861	25
36	44594	99983	44611	55389	00017	55406	24
37	45044	99983	45061	54939	00017	54956	23
38	45489	99982	45507	54493	00018	54510	22
39	45930	99982	45948	54052	00018	54070	21
40	8.46367	9.99982	8.46385	11.53615	10.00018	11.53633	20
41	46799	99981	46817	53183	00019	53201	19
42	47226	99981	47245	52755	00019	52774	18
43	47650	99981	47669	52331	00019	52350	17
44	48069	99980	48089	51911	00020	51931	16
45	48485	99980	48505	51495	00020	51515	15
46	48896	99979	48917	51083	00021	51104	14
47	49304	99979	49325	50675	00021	50696	13
48	49708	99979	49729	50271	00021	50292	12
49	50108	99978	50130	49870	00022	49892	11
50	8.50505	9.99978	8.50527	11.49473	10.00022	11.49495	10
51	50897	99977	50920	49080	00023	49103	9
52	51287	99977	51310	48690	00023	48713	8
53	51673	99977	51696	48304	00023	48327	7
54	52055	99976	52079	47921	00024	47945	6
55	52434	99976	52459	47541	00024	47566	5
56	52810	99975	52835	47165	00025	47190	4
57	53183	99975	53208	46792	00025	46817	3
58	53552	99974	53578	46422	00026	46448	2
59	53919	99974	53945	46055	00026	46081	1
60	54282	99974	54308	45692	00026	45718	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-fine.	Tangent.	Co-tang	Secant	Co-fecant.	
0	9.31788	9.99040	9.32747	10.67253	10.00960	10.68212	60
1	31847	99038	32810	67190	00962	68153	59
2	31907	99035	32872	67128	00965	68093	58
3	31966	99032	32933	67067	00968	68034	57
4	32025	99030	32995	67005	00970	67975	56
5	32084	99027	33057	66943	00973	67916	55
6	32143	99024	33119	66881	00976	67857	54
7	32202	99022	33180	66820	00978	67798	53
8	32261	99019	33242	66758	00981	67739	52
9	32319	99016	33303	66697	00984	67681	51
10	9.32378	9.99013	9.33365	10.66635	10.00987	10.67622	50
11	32437	99011	33426	66574	00989	67593	49
12	32495	99008	33487	66513	00992	67505	48
13	32553	99005	33548	66452	00995	67447	47
14	32612	99002	33609	66391	00998	67388	46
15	32670	99000	33670	66330	01000	67330	45
16	32728	98997	33731	66269	01003	67272	44
17	32786	98994	33792	66208	01006	67214	43
18	32844	98991	33853	66147	01009	67156	42
19	32902	98989	33913	66087	01011	67098	41
20	9.32960	9.98986	9.33974	10.66026	10.01014	10.67040	40
21	33018	98983	34034	65966	01017	66982	39
22	33075	98980	34095	65905	01020	66925	38
23	33133	98978	34155	65845	01022	66867	37
24	33190	98975	34215	65785	01025	66810	36
25	33248	98972	34276	65724	01028	66752	35
26	33305	98969	34336	65664	01031	66695	34
27	33362	98967	34396	65604	01033	66638	33
28	33420	98964	34456	65544	01036	66580	32
29	33477	98961	34516	65484	01039	66523	31
30	9.33534	9.98958	9.34576	10.65424	10.01042	10.66466	30
31	33591	98955	34635	65365	01045	66409	29
32	33647	98953	34695	65305	01047	66353	28
33	33704	98950	34755	65245	01050	66296	27
34	33761	98947	34814	65186	01053	66239	26
35	33818	98944	34874	65126	01056	66182	25
36	33874	98941	34933	65067	01059	66126	24
37	33931	98938	34992	65008	01062	66069	23
38	33987	98936	35051	64949	01064	66013	22
39	34043	98933	35111	64889	01067	65957	21
40	9.34100	9.98930	9.35170	10.64830	10.01070	10.65900	20
41	34156	98927	35229	64771	01073	65844	19
42	34212	98924	35288	64712	01076	65788	18
43	34268	98921	35347	64653	01079	65732	17
44	34324	98919	35405	64595	01081	65676	16
45	34380	98916	35464	64536	01084	65620	15
46	34436	98913	35523	64477	01087	65564	14
47	34491	98910	35581	64419	01090	65509	13
48	34547	98907	35640	64360	01093	65453	12
49	34602	98904	35698	64302	01096	65398	11
50	9.34658	9.98901	9.35757	10.64243	10.01099	10.65342	10
51	34713	98898	35815	64185	01102	65287	9
52	34769	98896	35873	64127	01104	65231	8
53	34824	98893	35931	64069	01107	65176	7
54	34879	98890	35989	64011	01110	65121	6
55	34934	98887	36047	63953	01113	65066	5
56	34989	98884	36105	63895	01116	65011	4
57	35044	98881	36163	63837	01119	64956	3
58	35099	98878	36221	63779	01122	64901	2
59	35154	98875	36279	63721	01125	64846	1
60	35209	98872	36336	63664	01128	64791	0
	Co fine	Sine.	Co-tang.	Tangent.	Co-fecant.	Secant.	M.

M.	Sine.	Co-fine.	Tangent.	Co-tang.	Secant.	Co-fecant.	
0	9.35209	9.98872	9.36336	10.63664	10.01128	10.64791	60
1	35263	98869	36394	63606	01131	64737	59
2	35318	98867	36452	63548	01133	64682	58
3	35373	98864	36509	63491	01136	64627	57
4	35427	98861	36566	63434	01139	64573	56
5	35481	98858	36624	63376	01142	64519	55
6	35536	98855	36681	63319	01145	64464	54
7	35590	98852	36738	63262	01148	64410	53
8	35644	98849	36795	63205	01151	64356	52
9	35698	98846	36852	63148	01154	64302	51
10	9.35752	9.98843	9.36909	10.63091	10.01157	10.64248	50
11	35806	98840	36966	63034	01160	64194	49
12	35860	98837	37023	62977	01163	64140	48
13	35914	98834	37080	62920	01166	64086	47
14	35968	98831	37137	62863	01169	64032	46
15	36022	98828	37193	62807	01172	63978	45
16	36075	98825	37250	62750	01175	63925	44
17	36129	98822	37306	62694	01178	63871	43
18	36182	98819	37363	62637	01181	63818	42
19	36236	98816	37419	62581	01184	63764	41
20	9.36289	9.98813	9.37476	10.62524	10.01187	10.63711	40
21	36342	98810	37532	62468	01190	63658	39
22	36395	98807	37588	62412	01193	63605	38
23	36449	98804	37644	62356	01196	63551	37
24	36502	98801	37700	62300	01199	63498	36
25	36555	98798	37756	62244	01202	63445	35
26	36608	98795	37812	62188	01205	63392	34
27	36660	98792	37868	62132	01208	63340	33
28	36713	98789	37924	62076	01211	63287	32
29	36766	98786	37980	62020	01214	63234	31
30	9.36819	9.98783	9.38035	10.61965	10.01217	10.63181	30
31	36871	98780	38091	61909	01220	63129	29
32	36924	98777	38147	61853	01223	63076	28
33	36976	98774	38202	61798	01226	63024	27
34	37028	98771	38257	61743	01229	62972	26
35	37081	98768	38313	61687	01232	62919	25
36	37133	98765	38368	61632	01235	62867	24
37	37185	98762	38423	61577	01238	62815	23
38	37237	98759	38479	61521	01241	62763	22
39	37289	98756	38534	61466	01244	62711	21
40	9.37341	9.98753	9.38589	10.61411	10.01247	10.62659	20
41	37393	98750	38644	61356	01250	62607	19
42	37445	98746	38699	61301	01254	62555	18
43	37497	98743	38754	61246	01257	62503	17
44	37549	98740	38808	61192	01260	62451	16
45	37600	98737	38863	61137	01263	62400	15
46	37652	98734	38918	61082	01266	62348	14
47	37703	98731	38972	61028	01269	62297	13
48	37755	98728	39027	60973	01272	62245	12
49	37806	98725	39082	60918	01275	62194	11
50	9.37858	9.98722	9.39136	10.60864	10.01278	10.62142	10
51	37909	98719	39190	60810	01281	62091	9
52	37960	98715	39245	60755	01285	62040	8
53	38011	98712	39299	60701	01288	61989	7
54	38062	98709	39353	60647	01291	61938	6
55	38113	98706	39407	60593	01294	61887	5
56	38164	98703	39461	60539	01297	61836	4
57	38215	98700	39515	60485	02300	61785	3
58	38266	98697	39569	60431	01303	61734	2
59	38317	98694	39623	60377	01306	61683	1
60	38368	98690	39677	60323	01310	61632	0
	Co-fine.	Sine.	Co-tang.	Tangent.	Co-fecant.	Secant.	M.

M.	Sine.	Co-fine.	Tangent.	Co-tang.	Secant.	Co-fecant.	
0	9.38368	9.98690	9.39677	10.60323	10.01310	10.61632	60
1	38418	98687	39731	60269	01313	61582	59
2	38469	98684	39785	60215	01316	61531	58
3	38519	98681	39838	60162	01319	61481	57
4	38570	98678	39892	60108	01322	61430	56
5	38620	98675	39945	60055	01325	61380	55
6	38670	98671	39999	60001	01329	61330	54
7	38721	98668	40052	59948	01332	61279	53
8	38771	98665	40106	59894	01335	61229	52
9	38821	98662	40159	59841	01338	61179	51
10	9.38871	9.98659	9.40212	10.59788	10.01341	10.61129	50
11	38921	98656	40266	59734	01344	61079	49
12	38971	98652	40319	59681	01348	61029	48
13	39021	98649	40372	59628	01351	60979	47
14	39071	98646	40425	59575	01354	60929	46
15	39121	98643	40478	59522	01357	60879	45
16	39170	98640	40531	59469	01360	60830	44
17	39220	98636	40584	59416	01364	60780	43
18	39270	98633	40636	59364	91367	60730	42
19	39319	98630	40689	59311	01370	60681	41
20	9.39369	9.98627	9.40742	10.59258	10.01373	10.60631	40
21	39418	98623	40795	59205	01377	60582	39
22	39467	98620	40847	59153	01380	60533	38
23	39517	98617	40900	59100	01383	60483	37
24	39566	98614	40952	59048	01386	60434	36
25	39615	98610	41005	58995	01390	60385	35
26	39664	98607	41057	58943	01393	60336	34
27	39713	98604	41109	58891	01396	60287	33
28	39762	98601	41161	58839	01399	60238	32
29	39811	98597	41214	58786	01403	60189	31
30	9.39860	9.98594	9.41226	10 58734	10.01406	10.60140	30
31	39909	98591	41318	58682	01409	60091	29
32	39958	98588	41370	58630	01412	60042	28
33	40006	98584	41422	58578	01418	59994	27
34	40055	98581	41474	58526	01419	59945	26
35	40103	98578	41526	58474	01422	59897	25
36	40152	98574	41578	58422	01426	59848	24
37	40200	98571	41629	58371	01429	59800	23
38	40249	98568	41681	58319	01432	59751	22
39	40297	98565	41733	58267	01435	59703	21
40	9.40346	9.98561	9.41784	10.58216	10.01439	10.59654	20
41	40394	98558	41836	58164	01442	59606	19
42	40442	98555	41887	58113	01445	59558	18
43	40490	98551	41939	58061	01449	59510	17
44	40538	98548	41990	58010	01452	59462	16
45	40586	98545	42041	57959	01455	59414	15
46	40634	98541	42093	57907	01459	59366	14
47	40682	98538	42144	57856	01462	59318	13
48	40730	98535	42195	57805	01465	59270	12
49	40778	98531	42246	57754	01469	59222	11
50	9.40825	9.98528	9.42297	10.57703	10.01472	10.59175	10
51	40873	98525	42348	57652	01475	59127	9
52	40921	98521	42399	57601	01479	59079	8
53	40968	98518	42450	57550	01482	59032	7
54	41016	98515	42501	57499	01485	58984	6
55	41063	98511	42552	57448	01489	58937	5
56	41110	98508	42603	57397	01492	58890	4
57	41158	98505	42653	57347	01495	58842	3
58	41205	98501	42704	57296	01499	58795	2
59	41252	98498	42755	57245	01502	58748	1
60	41300	98494	42805	57195	01506	58700	0
	Co-fine.	Sine.	Co-tang.	Tangent.	Co-fecant.	Secant.	M.

M.	Sine.	Co-fine.	Tangent.	Co-tang.	Secant.	Co-fecant	
0	9.41300	9.98494	9.42805	10.57195	10.01506	10.58700	60
1	41347	98491	42856	57144	01509	58653	59
2	41394	98488	42906	57094	01512	58606	58
3	41441	98484	42957	57043	01516	58559	57
4	41488	98481	43007	56993	01519	58512	56
5	41535	98477	43057	56943	01523	58465	55
6	41582	98474	43108	56892	01526	58418	54
7	41628	98471	43158	56842	01529	58372	53
8	41675	98467	43208	56792	01533	58325	52
9	41722	98464	43258	56742	01536	58278	51
10	9.41768	9.98460	9.43308	10.56692	10.01540	10.58232	50
11	41815	98457	43358	56642	01543	58185	49
12	41861	98453	43408	56592	01547	58139	48
13	41908	98450	43458	56542	01550	58092	47
14	41954	98447	43508	56492	01553	58046	46
15	42001	98443	43558	56442	01557	57999	45
16	42047	98440	43607	56393	01560	57953	44
17	42093	98436	43657	56343	01564	57907	43
18	42140	98433	43707	56293	01567	57860	42
19	42186	98429	43756	56244	01571	57814	41
20	9.42232	9.98426	9.43806	10.56194	10.01574	10.57768	40
21	42278	98422	43855	56145	01578	57722	39
22	42324	98419	43905	56095	01581	57676	38
23	42370	98415	43954	56046	01585	57630	37
24	42416	98412	44004	55996	01588	57584	36
25	42461	98409	44053	55947	01591	57539	35
26	42507	98405	44102	55898	01595	57493	34
27	42553	98402	44151	55849	01598	57447	33
28	42599	98398	44201	55799	01602	57401	32
29	42644	98395	44250	55750	01605	57356	31
30	9.42690	9.98391	9.44299	10.55701	10.01609	10.57310	30
31	42735	98388	44348	55652	01612	57265	29
32	42781	98384	44397	55603	01616	57219	28
33	42826	98381	44446	55554	01619	57174	27
34	42872	98377	44495	55505	01623	57128	26
35	42917	98373	44544	55456	01627	57083	25
36	42962	98370	44592	55408	01630	57038	24
37	43008	98366	44641	55359	01634	56992	23
38	43053	98363	44690	55310	01637	56947	22
39	43098	98359	44738	55262	01641	56902	21
40	9.43143	9.98356	9.44787	10.55213	10.01644	10.56857	20
41	43188	98352	44836	55164	01648	56812	19
42	43233	98349	44884	55116	01651	56767	18
43	43278	98345	44933	55067	01655	56722	17
44	43323	98342	44981	55019	01658	56677	16
45	43367	98338	45029	54971	01662	56633	15
46	43412	98334	45078	54922	01666	56588	14
47	43457	98331	45126	54874	01669	56543	13
48	43502	98327	45174	54826	01673	56498	12
49	43546	98324	45222	54778	01676	56454	11
50	9.43591	9.98320	9.45271	10.54729	10.01680	10.56409	10
51	43635	98317	45319	54681	01683	56365	9
52	43680	98313	45367	54633	01687	56320	8
53	43724	98309	45415	54585	01691	56276	7
54	43769	98306	45463	54537	01694	56231	6
55	43813	98302	45511	54489	01698	56187	5
56	43857	98299	45559	54441	01701	56143	4
57	43901	98295	45606	54394	01705	56099	3
58	43946	98291	45654	54346	01709	56054	2
59	43990	98288	45702	54298	01712	56010	1
60	44034	98284	45750	54250	01716	56966	0
	Co-fine.	Sine.	Co-tang.	Tangent.	Co-fecant	Secant.	M.

M.	Sine.	Co-fine.	Tangent.	Co-tang.	Secant.	Co-fecant.	
0	9.44034	9.98284	9.45750	10.54250	10.01716	10.55966	60
1	44078	98281	45797	54203	01719	55922	59
2	44122	98277	45845	54155	01723	55878	58
3	44166	98273	45892	54108	01727	55834	57
4	44210	98270	45940	54060	01730	55790	56
5	44253	98266	45987	54013	01734	55747	55
6	44297	98262	46035	53965	01738	55703	54
7	44341	98259	46082	53918	01741	55659	53
8	44385	98255	46130	53870	01745	55615	52
9	44428	98251	46177	53823	01749	55572	51
10	9.44472	9.98248	9.46224	10.53776	10.01752	10.55528	50
11	44516	98244	46271	53729	01756	55484	49
12	44559	98240	46319	53681	01760	55441	48
13	44602	98237	46366	53634	01763	55398	47
14	44646	98233	46413	53587	01767	55354	46
15	44689	98229	46460	53540	01771	55311	45
16	44733	98226	46507	53493	01774	55267	44
17	44776	98222	46554	53446	01778	55224	43
18	44819	98218	46601	53399	01782	55181	42
19	44862	98215	46648	53352	01785	55138	41
20	9.44905	9.98211	9.46694	10.53306	10.01789	10.55095	40
21	44948	98207	46741	53259	01793	55052	39
22	44992	98204	46788	53212	01796	55008	38
23	45035	98200	46835	53165	01800	54965	37
24	45077	98196	46881	53119	01804	54923	36
25	45120	98192	46928	53072	01808	54880	35
26	45163	98189	46975	53025	01811	54837	34
27	45206	98185	47021	52979	01815	54794	33
28	45249	98181	47068	52932	01819	54751	32
29	45292	98177	47114	52886	01823	54708	31
30	9.45334	9.98174	9.47160	10.52840	10.01826	10.54666	30
31	45377	98170	47207	52793	01830	54623	29
32	45419	98166	47253	52747	01834	54581	28
33	45462	98162	47299	52701	01838	54538	27
34	45504	98159	47346	52654	01841	54496	26
35	45547	98155	47392	52608	01845	54453	25
36	45589	98151	47438	52562	01849	54411	24
37	45632	98147	47484	52516	01853	54368	23
38	45674	98144	47530	52470	01856	54326	22
39	45716	98140	47576	52424	01860	54284	21
40	9.45758	9.98136	9.47622	10.52378	10.01864	10.54242	20
41	45801	98132	47668	52332	01868	54199	19
42	45843	98129	47714	52286	01871	54157	18
43	45885	98125	47760	52240	01875	54115	17
44	45927	98121	47806	52194	01879	54073	16
45	45969	98117	47852	52148	01883	54031	15
46	46011	98113	47897	52103	01887	53989	14
47	46053	98110	47943	52057	01890	53947	13
48	46095	98106	47989	52011	01894	53905	12
49	46136	98102	48035	51965	01898	53864	11
50	9.46178	9.98098	9.48080	10.51920	10.01902	10.53822	10
51	46220	98094	48126	51874	01906	53780	9
52	46262	98090	48171	51829	01910	53738	8
53	46303	98087	48217	51783	01913	53697	7
54	46345	98083	48262	51738	01917	53655	6
55	46386	98079	48307	51693	01921	53614	5
56	46428	98075	48353	51647	01925	53572	4
57	46469	98071	48398	51602	01929	53531	3
58	46511	98067	48443	51557	01933	53489	2
59	46552	98063	48489	51511	01937	53448	1
60	46594	98060	48534	51466	01940	53406	0
	Co fine.	Sine.	Co-tang.	Tangent.	Co-fecant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant	
0	9.08589	9.99675	9.08914	10.91086	10.00325	10.91411	60
1	08692	99674	09019	90981	00326	91308	59
2	08795	99672	09123	90877	00328	91205	58
3	08897	99670	09227	90773	00330	91103	57
4	08999	99669	09330	90670	00331	91001	56
5	09101	99667	09434	90566	00333	90899	55
6	09202	99666	09537	90463	00334	90798	54
7	09304	99664	09640	90360	00336	90696	53
8	09405	99662	09742	90258	00337	90595	52
9	09506	99661	09845	90155	00339	90494	51
10	9.09606	9.99659	9.09947	10.90053	10.00341	10.90394	50
11	09707	99658	10049	89951	00342	90293	49
12	09807	99656	10150	89850	00344	90193	48
13	09907	99655	10252	89748	00345	90093	47
14	10006	99653	10353	89647	00347	89994	46
15	10106	99651	10454	89546	00349	89894	45
16	10205	99650	10555	89445	00350	89795	44
17	10304	99648	10656	89344	00352	89696	43
18	10402	99647	10756	89244	00353	89598	42
19	10501	99645	10856	89144	00355	89499	41
20	9.10599	9.99643	9.10956	10.89044	10.00357	10.89401	40
21	10697	99642	11056	88944	00358	89303	39
22	10795	99640	11155	88845	00360	89205	38
23	10893	99638	11254	88746	00362	89107	37
24	10990	99637	11353	88647	00363	89010	36
25	11087	99635	11452	88548	00365	88913	35
26	11184	99633	11551	88449	00367	88816	34
27	11281	99632	11649	88351	00368	88719	33
28	11377	99630	11747	88253	00370	88623	32
29	11474	99629	11845	88155	00371	88526	31
30	9.11570	9.99627	9.11943	10.88057	10.00373	10.88430	30
31	11666	99625	12040	87960	00375	88334	29
32	11761	99624	12138	87862	00376	88239	28
33	11857	99622	12235	87765	00378	88143	27
34	11952	99620	12332	87668	00380	88048	26
35	12047	99618	12428	87572	00382	87953	25
36	12142	99617	12525	87475	00383	87858	24
37	12236	99615	12621	87379	00385	87764	23
38	12331	99613	12717	87283	00387	87669	22
39	12425	99612	12813	87187	00388	87575	21
40	9.12519	9.99610	9.12909	10.87091	10.00390	10.87481	20
41	12612	99608	13004	86996	00392	87388	19
42	12706	99607	13099	86901	00393	87294	18
43	12799	99605	13194	86806	00395	87201	17
44	12892	99603	13289	86711	00397	87108	16
45	12985	99601	13384	86616	00399	87015	15
46	13078	99600	13478	86522	00400	86922	14
47	13171	99598	13573	86427	00402	86829	13
48	13263	99596	13667	86333	00404	86737	12
49	13355	99595	13761	86239	00405	86645	11
50	9.13447	9.99593	9.13854	10.86140	10.00407	10.86553	10
51	23539	99591	13948	86052	00409	86461	9
52	13630	99589	14041	85959	00411	86370	8
53	13722	99588	14134	85866	00412	86278	7
54	13813	99586	14227	85773	00414	86187	6
55	13904	99584	14320	85680	00416	86096	5
56	13994	99582	14412	85588	00418	86006	4
57	13085	99581	14504	85496	00419	85915	3
58	14175	99579	14597	85403	00421	85825	2
59	14266	99577	14688	85312	00423	85734	1
60	14356	99575	14780	85220	00425	85644	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant	
0	9.48998	9.97821	9.51178	10.48822	10.02179	10.51002	60
1	49037	97817	51221	48779	02183	50963	59
2	49076	97812	51264	48736	02188	50924	58
3	49115	97808	51306	48694	02192	50885	57
4	49153	97804	51349	48651	02196	50847	56
5	49192	97800	51392	48608	02200	50808	55
6	49231	97796	51435	48565	02204	50769	54
7	49269	97792	51478	48522	02208	50731	53
8	49308	97788	51520	48480	02212	50692	52
9	49347	97784	51563	48437	02216	50653	51
10	9.49385	9.97779	9.51606	10.48394	10.02221	10.50615	50
11	49424	97775	51648	48352	02225	50576	49
12	49462	97771	51691	48309	02229	50538	48
13	49500	97767	51734	48266	02233	50500	47
14	49539	97763	51776	48224	02237	50461	46
15	49577	97759	51819	48181	02241	50423	45
16	49615	97754	51861	48139	02246	50385	44
17	49654	91750	51903	48097	02250	50346	43
18	49692	97746	51946	48054	02254	50308	42
19	49730	97742	51988	48012	02258	50270	41
20	9.49768	9.97738	9.52031	10.47969	10.02262	10.50232	40
21	49806	97734	52073	47927	02266	50194	39
22	49844	97729	52115	47885	02271	50156	38
23	49882	97725	52157	47843	02275	50118	37
24	49920	97721	52200	47800	02279	50080	36
25	49958	97717	52242	47758	02283	50042	35
26	49996	97713	52284	47716	02287	50004	34
27	50034	97708	52326	47674	02292	49966	33
28	50072	97704	52368	47632	02296	49928	32
29	50110	97700	52410	47590	02300	49890	31
30	9.50148	9.97696	9.52452	10.47548	10.02304	10.49852	30
31	50185	97691	52494	47506	02309	49815	29
32	50223	97687	52536	47464	02313	49777	28
33	50261	97683	52578	47422	02317	49739	27
34	50298	97679	52620	47380	02321	49702	26
35	50336	97674	52661	47339	02326	49664	25
36	50374	97670	52703	47297	02330	49626	24
37	50411	97666	52745	47255	02334	49589	23
38	50449	97662	52787	47213	02338	49551	22
39	50486	97657	52829	47171	02343	49514	21
40	9.50523	9.97653	9.52870	10.47130	10.02347	10.49477	20
41	50561	97649	52912	47088	02351	49439	19
42	50598	97645	52953	47047	02355	49402	18
43	50635	97640	52995	47005	02360	49365	17
44	50673	97636	53037	46963	02364	49327	16
45	50710	97632	53078	46922	02368	49290	15
46	50747	97628	53120	46880	02372	49253	14
47	50784	97623	53161	46839	02377	49216	13
48	50821	97619	53202	46798	02381	49179	12
49	50858	97615	53244	46756	02385	49142	11
50	9.50896	9.97610	9.53285	10.46715	10.02390	10.49104	10
51	50933	97606	53327	46673	02394	49067	9
52	50970	97602	53368	46632	02398	49030	8
53	51007	97597	53409	46591	02403	48993	7
54	51043	97593	53450	46550	02407	48957	6
55	51080	97589	53492	46508	02411	48920	5
56	51117	97584	53533	46467	02416	48883	4
57	51154	97580	53574	46426	02420	48846	3
58	51191	97576	53615	46385	02424	48809	2
59	51227	97571	53656	46344	02429	48773	1
60	51264	97567	53697	46303	02433	48736	0
	Co-sine.	Sine.	Co-tang.	Tangent	Co-secant	Secant.	M.

M.	Sine.	Co sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.19433	9.99462	9.19971	10.80029	10.00538	10.80567	60
1	19513	99460	20053	79947	00540	80487	59
2	19592	99458	20134	79866	00542	80408	58
3	19672	99456	20216	79784	00544	80328	57
4	19751	99454	20297	79703	00546	80249	56
5	19830	99452	20378	79622	00548	80170	55
6	19909	99450	20459	79541	00550	80091	54
7	19988	99448	20540	79460	00552	80012	53
8	20067	99446	20621	79379	00554	79933	52
9	20145	99444	20701	79299	00556	79855	51
10	9.20223	9.99442	9.20782	10.79218	10.00558	10.79777	50
11	20302	99440	20862	79138	00560	79698	49
12	20380	99438	20942	79058	00562	79620	48
13	20458	99436	21022	78978	00564	79542	47
14	20535	99434	21102	78898	00566	79465	46
15	20613	99432	21182	78818	00568	79387	45
16	20691	99429	21261	78739	00571	79309	44
17	20768	99427	21341	78659	00573	79232	43
18	20845	99425	21420	78580	00575	79155	42
19	20922	99423	21499	78501	00577	79078	41
20	9.20999	9.99421	9.21578	10.78422	10.00579	10.79001	40
21	21076	99419	21657	78343	00581	78924	39
22	21153	99417	21736	78264	00583	78847	38
23	21229	99415	21814	78186	00585	78771	37
24	21306	99413	21893	78107	00587	78694	36
25	21382	99411	21971	78029	00589	78618	35
26	21458	99409	22049	77951	00591	78542	34
27	21534	99427	22127	77873	00593	78466	33
28	21610	99404	22205	77795	00596	78390	32
29	21685	99402	22283	77717	00598	78315	31
30	9.21761	9.99400	9.22361	10.77639	10.00600	10.78239	30
31	21836	99398	22438	77562	00602	78164	29
32	21912	99396	22516	77484	00604	78088	28
33	21987	99394	22593	77407	00606	78013	27
34	22062	99392	22670	77330	00608	77938	26
35	22137	99390	22747	77253	00610	77863	25
36	22211	99388	22824	77176	00612	77789	24
37	22286	99385	22901	77099	00615	77714	23
38	22361	99383	22977	77023	00617	77639	22
39	22435	99381	23054	76946	00619	77565	21
40	9.22509	9.99379	9.23130	10.76870	10.00621	10.77491	20
41	22583	99377	13206	76794	00623	77417	19
42	22657	99375	23283	76717	00625	77342	18
43	22731	99372	23359	76641	00628	77269	17
44	22805	99370	23435	76565	00630	77195	16
45	22878	99368	23510	76490	00632	77122	15
46	22952	99366	22586	76414	00634	77048	14
47	23025	99364	23661	76339	00636	76975	13
48	23098	99362	23737	76263	00638	76902	12
49	23171	99359	23812	76188	00641	76829	11
50	9.23244	9.99357	9.23887	10.76113	10.00643	10.76756	10
51	23317	99355	23962	76038	00645	76683	9
52	23390	99353	24037	75963	00647	76610	8
53	23462	99351	24112	75888	00649	76538	7
54	23535	99348	24186	75814	00652	76465	6
55	23607	99346	24261	75739	00654	76393	5
56	23679	99344	24335	75665	00656	76321	4
57	23752	99342	24410	75590	00658	76248	3
58	23823	99340	24484	75516	00660	76177	2
59	23895	99337	24558	75442	00663	76105	1
60	23967	99335	24632	75368	00665	76033	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.53405	9.97299	9.56107	10.43893	10.02701	10.46595	60
1	53440	97294	56146	43854	02706	46560	59
2	53475	97289	56185	43815	02711	46525	58
3	53509	97285	56224	43776	02715	46491	57
4	53544	97280	56264	43736	02720	46456	56
5	53578	97276	56303	43697	02724	46422	55
6	53613	97271	56342	43658	02729	46387	54
7	53647	97266	56381	43619	02734	46353	53
8	53682	97262	56420	43580	02738	46318	52
9	53716	97257	56459	43541	02743	46284	51
10	9.53751	9.97252	9.56498	10.43502	10.02748	10.46249	50
11	53785	97248	56537	43463	02752	46215	49
12	53819	97243	56576	43424	02757	46181	48
13	53854	97238	56615	43385	02762	46146	47
14	53888	97234	56654	43346	02766	46112	46
15	53922	97229	56693	43307	02771	46078	45
16	53957	97224	56732	43268	02776	46043	44
17	53991	97220	56771	43229	02780	46009	43
18	54025	97215	56810	43190	02785	45975	42
19	54059	97210	56849	43151	02790	45941	41
20	9.54093	9.97206	9.56887	10.43113	10.02794	10.45907	40
21	54127	97201	56926	43074	02799	45873	39
22	54161	97196	56965	43035	02804	45839	38
23	54195	97192	57004	42996	02808	45805	37
24	54229	97187	57042	42958	02813	45771	36
25	54263	97182	57081	42919	02818	45737	35
26	54297	97178	57120	42880	02822	45703	34
27	54331	97173	57158	42842	02827	45669	33
28	54365	97168	57197	42803	02832	45635	32
29	54399	97163	57235	42765	02837	45601	31
30	9.54433	9.97159	9.57274	10.42726	10.02841	10.45567	30
31	54466	97154	57312	42688	02846	45534	29
32	54500	97149	57351	42649	02851	45500	28
33	54534	97145	57389	42611	02855	45466	27
34	54567	97140	57428	42572	02860	45433	26
35	54601	97135	57466	42534	02865	45399	25
36	54635	97130	57504	42496	02870	45365	24
37	54668	97126	57543	42457	02874	45332	23
38	54702	97121	57581	42419	02879	45298	22
39	54735	97116	57619	42381	02884	45265	21
40	9.54769	9.97111	9.57658	10.42342	10.02889	10.45231	20
41	54802	97107	57696	42304	02893	45198	19
42	54836	97102	57734	42266	02898	45164	18
43	54869	97097	57772	42228	02903	45131	17
44	54903	97092	57810	42190	02908	45097	16
45	54936	97087	57849	42151	02913	45064	15
46	54969	97083	57887	42113	02917	45031	14
47	55003	97078	57925	42075	02922	44997	13
48	55036	97073	57963	42037	02927	44964	12
49	55069	97068	58001	41999	02932	44931	11
50	9.55102	9.97063	9.58039	10.41961	10.02937	10.44898	10
51	55136	97059	58077	41923	02941	44864	9
52	55169	97054	58115	41885	02946	44831	8
53	55202	97049	58153	41847	02951	44798	7
54	55235	97044	58191	41809	02956	44765	6
55	55268	97039	58229	41771	02961	44732	5
56	55301	97035	58267	41733	02965	44699	4
57	55334	97030	58304	41696	02970	44666	3
58	55367	97025	58342	41658	02975	44633	2
59	55400	97020	58380	41620	02980	44600	1
60	55433	97015	58418	41582	02985	44567	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co secant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.28060	9.99195	9.28865	10.71135	10.00805	10.71940	60
1	28125	99192	28933	71067	00808	71875	59
2	28190	99190	29000	71000	00810	71810	58
3	28254	99187	29067	70933	00813	71746	57
4	28319	99185	29134	70866	00815	71681	56
5	28384	99182	29201	70799	00818	71616	55
6	28448	99180	29268	70732	00820	71552	54
7	28512	99177	29335	70665	00823	71488	53
8	28577	99175	29402	70598	00825	71423	52
9	28641	99172	29468	70532	00828	71359	51
10	9.28705	9.99170	9.29535	10.70465	10.00830	10.71295	50
11	28769	99167	29601	70399	00833	71231	49
12	28833	99165	29668	70332	00835	71167	48
13	28896	99162	29734	70266	00838	71104	47
14	28960	99160	29800	70200	00840	71040	46
15	29024	99157	29866	70134	00843	70976	45
16	29087	99155	29932	70068	00845	70913	44
17	29150	99152	29998	70002	00848	70850	43
18	29214	99150	30064	69936	00850	70786	42
19	29277	99147	30130	69870	00853	70723	41
20	9.29340	9.99145	9.30195	10.69805	10.00855	10.70660	40
21	29403	99142	30261	69739	00858	70597	39
22	29466	99140	30326	69674	00860	70534	38
23	29529	99137	30391	69609	00863	70471	37
24	29591	99135	30457	69543	00865	70409	36
25	29654	99132	30522	69478	00868	70346	35
26	29716	99130	30587	69413	00870	70284	34
27	29779	99127	30652	69348	00873	70221	33
28	29841	99124	30717	69283	00876	70159	32
29	29903	99122	30782	69218	00878	70097	31
30	9.29966	9.99119	9.30846	10.69154	10.00881	10.70034	30
31	30028	99117	30911	69089	00883	69972	29
32	30090	99114	30975	69025	00886	69910	28
33	30151	99112	31040	68960	00888	69849	27
34	30213	99109	31104	68896	00891	69787	26
35	30275	99106	31168	68832	00894	69725	25
36	30336	99104	31233	68767	00896	69664	24
37	30398	99101	31297	68703	00899	69602	23
38	30459	99099	31361	68639	00901	69541	22
39	30521	99096	31425	68575	00904	69479	21
40	9.30582	9.99093	9.31489	10.68511	10.00907	10.69418	20
41	30643	99091	31552	68448	00909	69357	19
42	30704	99088	31616	68384	00912	69296	18
43	30765	99086	31679	68321	00914	69235	17
44	30826	99083	31743	68257	00917	69174	16
45	30887	99080	31806	68194	00920	69113	15
46	30947	99078	31870	68130	00922	69053	14
47	31008	99075	31933	68067	00925	68992	13
48	31068	99072	31996	68004	00928	68932	12
49	31129	99070	32059	67941	00930	68871	11
50	9.31189	9.99067	9.32122	10.67878	10.00933	10.68811	10
51	31250	99064	32185	67815	00936	68750	9
52	31310	99062	32248	67752	00938	68690	8
53	31370	99059	32311	67689	00941	68630	7
54	31430	99056	32373	67627	00944	68570	6
55	31490	99054	32436	67564	00946	68510	5
56	31549	99051	32498	67502	00949	68451	4
57	31609	99048	32561	67439	00952	68391	3
58	31669	99046	32623	67377	00954	68331	2
59	31728	99043	32685	67315	00957	68272	1
60	31788	99040	32747	67253	00960	68212	0
	Co-sine.	Sine.	Co tang.	Tangent.	Co-secant	Secant.	M.

M.	Sine.	Co-fine.	Tangent.	Co-tang	Secant	Co-fecant.	
0	9.31788	9.99040	9.32747	10.67253	10.00960	10.68212	60
1	31847	99038	32810	67190	00962	68153	59
2	31907	99035	32872	67128	00965	68093	58
3	31966	99032	32933	67067	00968	68034	57
4	32025	99030	32995	67005	00970	67975	56
5	32084	99027	33057	66943	00973	67916	55
6	32143	99024	33119	66881	00976	67857	54
7	32202	99022	33180	66820	00978	67798	53
8	32261	99019	33242	66758	00981	67739	52
9	32319	99016	33303	66697	00984	67681	51
10	9.32378	9.99013	9.33365	10.66635	10.00987	10.67622	50
11	32437	99011	33426	66574	00989	67593	49
12	32495	99008	33487	66513	00992	67505	48
13	32553	99005	33548	66452	00995	67447	47
14	32612	99002	33609	66391	00998	67388	46
15	32670	99090	33670	66330	01000	67330	45
16	32728	98997	33731	66269	01003	67272	44
17	32786	98994	33792	66208	01006	67214	43
18	32844	98991	33853	66147	01009	67156	42
19	32902	98989	33913	66087	01011	67098	41
20	9.32960	9.98986	9.33974	10.66026	10.01014	10.67040	40
21	33018	98983	34034	65966	01017	66982	39
22	33075	98980	34095	65905	01020	66925	38
23	33133	98978	34155	65845	01022	66867	37
24	33190	98975	34215	65785	01025	66810	36
25	33248	98972	34276	65724	01028	66752	35
26	33305	98969	34336	65664	01031	66695	34
27	33362	98967	34396	65604	01033	66638	33
28	33420	98964	34456	65544	01036	66580	32
29	33477	98961	34516	65484	01039	66523	31
30	9.33534	9.98958	9.34576	10.65424	10.01042	10.66466	30
31	33591	98955	34635	65365	01045	66409	29
32	33647	98953	34695	65305	01047	66353	28
33	33704	98950	34755	65245	01050	66296	27
34	33761	98947	34814	65186	01053	66239	26
35	33818	98944	34874	65126	01056	66182	25
36	33874	98941	34933	65067	01059	66126	24
37	33931	98938	34992	65008	01062	66069	23
38	33987	98936	35051	64949	01064	66013	22
39	34043	98933	35111	64889	01067	65957	21
40	9.34100	9.98930	9.35170	10.64830	10.01070	10.65900	20
41	34156	98927	35229	64771	01073	65844	19
42	34212	98924	35288	64712	01076	65788	18
43	34268	98921	35347	64653	01079	65732	17
44	34324	98919	35405	64595	01081	65676	16
45	34380	98916	35464	64536	01084	65620	15
46	34436	98913	35523	64477	01087	65564	14
47	34491	98910	35581	64419	01090	65509	13
48	34547	98907	35640	64360	01093	65453	12
49	34602	98904	35698	64302	01096	65398	11
50	9.34658	9.98901	9.35757	10.64243	10.01099	10.65342	10
51	34713	98898	35815	64185	01102	65287	9
52	34769	98896	35873	64127	01104	65231	8
53	34824	98893	35931	64069	01107	65176	7
54	34879	98890	35989	64011	01110	65121	6
55	34934	98887	36047	63953	01113	65066	5
56	34989	98884	36105	63895	01116	65011	4
57	35044	98881	36163	63837	01119	64956	3
58	35099	98878	36221	63779	01122	64901	2
59	35154	98875	36279	63721	01125	64846	1
60	35209	98872	36336	63664	01128	64791	0
	Co fine	Sine.	Co-tang.	Tangent.	Co-fecant.	Secant.	M.

M.	Sine.	Co-ſine	Tangent.	Co-tang.	Secant.	Co-ſecant.	
0	9.59188	9.96403	9.62785	10.37215	10.03597	10.40812	60
1	59218	96397	62820	37180	03603	40782	59
2	59247	96392	62855	37145	03608	40753	58
3	59277	96387	62890	37110	03613	40723	57
4	59307	96381	62926	37074	03619	40693	56
5	59336	96376	62961	37039	03624	40664	55
6	59366	96370	62996	37004	03630	40634	54
7	59396	96365	63031	36969	03635	40604	53
8	59425	96360	63066	36934	03640	40575	52
9	59455	96354	63101	36899	03646	40545	51
10	9.59484	9.96349	9.63135	10.36865	10.03651	10.40516	50
11	59514	96343	63170	36830	03657	40486	49
12	59543	96338	63205	36795	03662	40457	48
13	59573	96333	63240	36760	03667	40427	47
14	59602	96327	63275	36725	03673	40398	46
15	59632	96322	63310	36690	03678	40368	45
16	59661	96316	63345	36655	03684	40339	44
17	59690	96311	63379	36621	03689	40310	43
18	59720	96305	63414	36586	03695	40280	42
19	59749	96300	63449	36551	03700	40251	41
20	9.59778	9.96294	9.63484	10.36516	10.03706	10.40222	40
21	59808	96289	63519	36481	03711	40192	39
22	59837	96284	63553	36447	03716	40163	38
23	59866	96278	63588	36412	03722	40134	37
24	59895	96273	63623	36377	03727	40105	36
25	59924	96267	63657	36343	03733	40076	35
26	59954	96262	63692	36308	03738	40046	34
27	59983	96256	63726	36274	03744	40017	33
28	60012	96251	63761	36239	03749	39988	32
29	60041	96245	63796	36204	03755	39959	31
30	9.60070	9.96240	9.63830	10.36170	10.03760	10.39930	30
31	60099	96234	63865	36135	03766	39901	29
32	60128	96229	63899	36101	03771	39872	28
33	60157	96223	63934	36066	03777	39843	27
34	60186	96218	63968	36032	03782	39814	26
35	60215	96212	64003	35997	03788	39785	25
36	60244	96207	64037	35963	03793	39756	24
37	60273	96201	64072	35928	03799	39727	23
38	60302	96196	64106	35894	03804	39698	22
39	60331	96190	64140	35860	03810	39669	21
40	9.60359	9.96185	9.64175	10.35825	10.03815	10.39641	20
41	60388	96179	64209	35791	03821	39612	19
42	60417	96174	64243	35757	03826	39583	18
43	60446	96168	64278	35722	03832	39554	17
44	60474	96162	64312	35688	03838	39526	16
45	60503	96157	64346	35654	03843	39497	15
46	60532	96151	64381	35619	03849	39468	14
47	60561	96146	64415	35585	03854	39439	13
48	60589	96140	64449	35551	03860	39411	12
49	60618	96135	64483	35517	03865	39382	11
50	9.60646	9.96129	9.64517	10.35483	10.03871	10.39354	10
51	60675	96123	64552	35448	03877	39325	9
52	60704	96118	64586	35414	03882	39296	8
53	60732	96112	64620	35380	03888	39268	7
54	60761	96107	64654	35346	03893	39239	6
55	60789	96101	64688	35312	03899	39211	5
56	60818	96095	64722	35278	03905	39182	4
57	60846	96090	64756	35244	03910	39154	3
58	60875	96084	64790	35210	03916	39125	2
59	60903	96079	64824	35176	03921	39097	1
60	60931	96073	64858	35142	03927	39069	0
	Co ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.60931	9.96073	9.64858	10.35142	10.03927	10.39069	60
1	60960	96067	64892	35108	03933	39040	59
2	60988	96062	64926	35074	03938	39012	58
3	61016	96056	64960	35040	03944	38984	57
4	61045	96050	64994	35006	03950	38955	56
5	61073	96045	65028	34972	03955	38927	55
6	61101	96039	65062	34938	03961	38899	54
7	61129	96034	65096	34904	03966	38871	53
8	61158	96028	65130	34870	03972	38842	52
9	61186	96022	65164	34836	03978	38814	51
10	9.61214	9.96017	9.65197	10.34803	10.03983	10.38786	50
11	61242	96011	65231	34769	03989	38758	49
12	61270	96005	65265	34735	03995	38730	48
13	61298	96000	65299	34701	04000	38702	47
14	61326	95994	65333	34667	04006	38674	46
15	61354	95988	65366	34634	04012	38646	45
16	61382	95982	65400	34600	04018	38618	44
17	61411	95977	65434	34566	04023	38589	43
18	61438	95971	65467	34533	04029	38562	42
19	61466	95965	65501	34499	04035	38534	41
20	9.61494	9.95960	9.65535	10.34465	10.04040	10.38506	40
21	61522	95954	65568	34432	04046	38478	39
22	61550	95948	65602	34398	04052	38450	38
23	61578	95942	65636	34364	04058	38422	37
24	61606	95937	65669	34331	04063	38394	36
25	61634	95931	65703	34297	04069	38366	35
26	61662	95925	65736	34264	04075	38338	34
27	61689	95920	65770	34230	04080	38311	33
28	61717	95914	65803	34197	04086	38283	32
29	61745	95908	65837	34163	04092	38255	31
30	9.61773	9.95902	9.65870	10.34130	10.04098	10.38227	30
31	61800	95897	65904	34096	04103	38200	29
32	61828	95891	65937	34063	04109	38172	28
33	61856	95885	65971	34029	04115	38144	27
34	61883	95879	66004	33996	04121	38117	26
35	61911	95873	66038	33962	04127	38089	25
36	61939	95868	66071	33929	04132	38061	24
37	61966	95862	66104	33896	04138	38034	23
38	61994	95856	66138	33862	04144	38006	22
39	62021	95850	66171	33829	04150	37979	21
40	9.62049	9.95844	9.66204	10.33796	10.04156	10.37951	20
41	62076	95839	66238	33762	04161	37924	19
42	62104	95833	66271	33729	04167	37896	18
43	62131	95827	66304	33696	04173	37869	17
44	62159	95821	66337	33663	04179	37841	16
45	62186	95815	66371	33629	04185	37814	15
46	62214	95810	66404	33596	04190	37786	14
47	62241	95804	66437	33563	04196	37759	13
48	62268	95798	66470	33530	04202	37732	12
49	62296	95792	66503	33497	04208	37704	11
50	9.62323	9.95786	9.66537	10.33463	10.04214	10.37657	10
51	62350	95780	66570	33430	04220	37650	9
52	62377	95775	66603	33397	04225	37623	8
53	62405	95769	66636	33364	04231	37595	7
54	62432	95763	66669	33331	04237	37568	6
55	62459	95757	66702	33298	04243	37541	5
56	62486	95751	66735	33265	04249	37514	4
57	62513	95745	66768	33232	04255	37487	3
58	62541	95739	66801	33199	04261	37459	2
59	62568	95733	66834	33166	04266	37432	1
60	62595	95728	66867	33133	04272	37405	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

65 Degrees.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.62595	95728	9.66867	10.33133	10.04272	10.37405	60
1	62622	95722	66900	33100	04278	37378	59
2	62649	95716	66933	33067	04284	37351	58
3	62676	95710	66966	33034	04290	37324	57
4	62703	95704	66999	33001	04296	37297	56
5	62730	95698	67032	32968	04302	37270	55
6	62757	95692	67065	32935	04308	37243	54
7	62784	95686	67098	32902	04314	37216	53
8	62811	95680	67131	32869	04320	37189	52
9	62838	95674	67163	32837	04326	37162	51
10	9.62865	9.95668	9.67196	10.32804	10.04332	10.37135	50
11	62892	95663	67229	32771	04337	37108	49
12	62918	95657	67262	32738	04343	37082	48
13	62945	95651	67295	32705	04349	37055	47
14	62972	95645	67327	32673	04355	37028	46
15	62999	95639	67360	32640	04361	37001	45
16	63026	95633	67393	32607	04367	36974	44
17	63052	95627	67426	32574	04373	36948	43
18	63079	95621	67458	32542	04379	36921	42
19	63106	95615	67491	32509	04385	36894	41
20	9.63133	9.95609	9.67524	10.32476	10.04391	10.36867	40
21	63159	95603	67556	32444	04397	36841	39
22	63186	95597	67589	32411	04403	36814	38
23	63213	95591	67622	32378	04409	36787	37
24	63239	95585	67654	32346	04415	36761	36
25	63266	95579	67687	32313	04421	36734	35
26	63292	95573	67719	32281	04427	36708	34
27	63319	95567	67752	32248	04433	36681	33
28	63345	95561	67785	32215	04439	36655	32
29	63372	95555	67817	32183	04445	36628	31
30	9.63398	9.95549	9.67850	10.32150	10.04451	10.36602	30
31	63425	95543	67882	32118	04457	36575	29
32	63451	95537	67915	32085	04463	36549	28
33	63478	95531	67947	32053	04469	36522	27
34	63504	95525	67980	32020	04475	36496	26
35	63531	95519	68012	31988	04481	36469	25
36	63557	95513	68044	31956	04487	36443	24
37	63583	95507	68077	31923	04493	36417	23
38	63610	95500	68109	31891	04500	36390	22
39	63636	95494	68142	31858	04506	36364	21
40	9.63662	9.95488	9.68174	10.31826	10.04512	10.36338	20
41	63689	95482	68206	31794	04518	36311	19
42	63715	95476	68239	31761	04524	36285	18
43	63741	95470	68271	31729	04530	36259	17
44	63767	95464	68303	31697	04536	36233	16
45	63794	95458	68336	31664	04542	36206	15
46	63820	95452	68368	31632	04548	36180	14
47	63846	95446	68400	31600	04554	36154	13
48	63872	95440	68432	31568	04560	36128	12
49	63898	95434	68465	31535	04566	36102	11
50	9.63924	9.95427	9.68497	10.31503	10.04573	10.36076	10
51	63950	95421	68529	31471	04579	36050	9
52	63976	95415	68561	31439	04585	36024	8
53	64002	95409	68593	31407	04591	35998	7
54	64028	95403	68626	31374	04597	35972	6
55	64054	95397	68658	31342	04603	35946	5
56	64080	95391	68690	31310	04609	35920	4
57	64106	95384	68722	31278	04616	35894	3
58	64132	95378	68754	31246	04622	35868	2
59	64158	95372	68786	31214	04628	35842	1
60	64184	95366	68818	31182	04634	35816	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.44034	9.98284	9.45750	10.54250	10.01716	10.55966	60
1	44078	98281	45797	54203	01719	55922	59
2	44122	98277	45845	54155	01723	55878	58
3	44166	98273	45892	54108	01727	55834	57
4	44210	98270	45940	54060	01730	55790	56
5	44253	98266	45987	54013	01734	55747	55
6	44297	98262	46035	53965	01738	55703	54
7	44341	98259	46082	53918	01741	55659	53
8	44385	98255	46130	53870	01745	55615	52
9	44428	98251	46177	53823	01749	55572	51
10	9.44472	9.98248	9.46224	10.53776	10.01752	10.55528	50
11	44516	98244	46271	53729	01756	55484	49
12	44559	98240	46319	53681	01760	55441	48
13	44602	98237	46366	53634	01763	55398	47
14	44646	98233	46413	53587	01767	55354	46
15	44689	98229	46460	53540	01771	55311	45
16	44733	98226	46507	53493	01774	55267	44
17	44776	98222	46554	53446	01778	55224	43
18	44819	98218	46601	53399	01782	55181	42
19	44862	98215	46648	53352	01785	55138	41
20	9.44905	9.98211	9.46694	10.53306	10.01789	10.55095	40
21	44948	98207	46741	53259	01793	55052	39
22	44992	98204	46788	53212	01796	55008	38
23	45035	98200	46835	53165	01800	54965	37
24	45077	98196	46881	53119	01804	54923	36
25	45120	98192	46928	53072	01808	54880	35
26	45163	98189	46975	53025	01811	54837	34
27	45206	98185	47021	52979	01815	54794	33
28	45249	98181	47068	52932	01819	54751	32
29	45292	98177	47114	52886	01823	54708	31
30	9.45334	9.98174	9.47160	10.52840	10 01826	10.54666	30
31	45377	98170	47207	52793	01830	54623	29
32	45419	98166	47253	52747	01834	54581	28
33	45462	98162	47299	52701	01838	54538	27
34	45504	98159	47346	52654	01841	54496	26
35	45547	98155	47392	52608	01845	54453	25
36	45589	98151	47438	52562	01849	54411	24
37	45632	98147	47484	52516	01853	54368	23
38	45674	98144	47530	52470	01856	54326	22
39	45716	98140	47576	52424	01860	54284	21
40	9.45758	9.98136	9.47622	10.52378	10.01864	10.54242	20
41	45801	98132	47668	52332	01868	54199	19
42	45843	98129	47714	52286	01871	54157	18
43	45885	98125	47760	52240	01875	54115	17
44	45927	98121	47806	52194	01879	54073	16
45	45969	98117	47852	52148	01883	54031	15
46	46011	98113	47897	52103	01887	53989	14
47	46053	98110	47943	52057	01890	53947	13
48	46095	98106	47989	52011	01894	53905	12
49	46136	98102	48035	51965	01898	53864	11
50	9.46178	9.98098	9.48080	10.51920	10.01902	10.53822	10
51	46220	98094	48126	51874	01906	53780	9
52	46262	98090	48171	51829	01910	53738	8
53	46303	98087	48217	51783	01913	53697	7
54	46345	98083	48262	51738	01917	53655	6
55	46386	98079	48307	51693	01921	53614	5
56	46428	98075	48353	51647	01925	53572	4
57	46469	98071	48398	51602	01929	53531	3
58	46511	98067	48443	51557	01933	53489	2
59	46552	98063	48489	51511	01937	53448	1
60	46594	98060	48534	51466	01940	53406	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.46594	9.98060	9.48534	10.51466	10.01940	10.53406	60
1	46635	98056	48579	51421	01944	53365	59
2	46676	98052	48624	51376	01948	53324	58
3	46717	98048	48669	51331	01952	53283	57
4	46758	98044	48714	51286	01956	53242	56
5	46800	98040	48759	51241	01960	53200	55
6	46841	98036	48804	51196	01964	53159	54
7	46882	98032	48849	51151	01968	53118	53
8	46923	98029	48894	51106	01971	53077	52
9	46964	98025	48939	51061	01975	53036	51
10	9.47005	9.98021	9.48984	10.51016	10.01979	10.52995	50
11	47045	98017	49029	50971	01983	52955	49
12	47086	98013	49073	50927	01987	52914	48
13	47127	98009	49118	50882	01991	52873	47
14	47168	98005	49163	50837	01995	52832	46
15	47209	98001	49207	50793	01999	52791	45
16	47249	97997	49252	50748	02003	52751	44
17	47290	97993	49296	50704	02007	52710	43
18	47330	97989	49341	50659	02011	52670	42
19	47371	97986	49385	50615	02014	52629	41
20	9.47411	9.97982	9.49430	10.50570	10.02018	10.52589	40
21	47452	97978	49474	50526	02022	52548	39
22	47492	97974	49519	50481	02026	52508	38
23	47533	97970	49563	50437	02030	52467	37
24	47573	97966	49607	50393	02034	52427	36
25	47613	97962	49652	50348	02038	5238[illegible]	35
26	47654	97958	49696	50304	02042	52346	34
27	47694	97954	49740	50260	02046	52306	33
28	47734	97950	49784	50216	02050	52266	32
29	47774	97946	49828	50172	02054	52226	31
30	9.47814	9.97942	9.49872	10.50128	10.02058	10.52186	30
31	47854	97938	49916	50084	02062	52146	29
32	47894	97934	49960	50040	02066	52106	28
33	47934	97930	50004	49996	02070	52066	27
34	47974	97926	50048	49952	02074	52026	26
35	48014	97922	50092	49908	02078	51986	25
36	48054	97918	50136	49864	02082	51946	24
37	48094	97914	50180	49820	02086	51906	23
38	48133	97910	50223	49777	02090	51867	22
39	48173	97906	50267	49733	02094	51827	21
40	9.48213	9.97902	9.50311	10.49689	10.02098	10.51787	20
41	48252	97898	50355	49645	02102	51748	19
42	48292	97894	50398	49602	02106	51708	18
43	48332	97890	50442	49558	02110	51668	17
44	48371	97886	50485	49515	02114	51629	16
45	48411	97882	50529	49471	02118	51589	15
46	48450	97878	50572	49428	02122	51550	14
47	48490	97874	50616	49384	02126	51510	13
48	48529	97870	50659	49341	02130	51471	12
49	48568	97866	50703	49297	02134	51432	11
50	9.48607	9.97861	9.50746	10.49254	10.02139	10.51393	10
51	48647	97857	50789	49211	02143	51353	9
52	48686	97853	50833	49167	02147	51314	8
53	48725	97849	50876	49124	02151	51275	7
54	48764	97845	50919	49081	02155	51236	6
55	48803	97841	50962	49038	02159	51197	5
56	48842	97837	51005	48995	02163	51158	4
57	48881	97833	51048	48952	02167	51119	3
58	48920	97829	51092	48908	02171	51080	2
59	48959	97825	51135	48865	02175	51041	1
60	48998	97821	51178	48822	02179	51002	0
	Co-sine.	Sine.	Co-tang.	Tangent	Co-secant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.67161	9.94593	9.72567	10.27433	10.05407	10.32839	60
1	67185	94587	72598	27402	05413	32815	59
2	67208	94580	72628	27372	05420	32792	58
3	67232	94573	72659	27341	05427	32768	57
4	67256	94567	72689	27311	05433	32744	56
5	67280	94560	72720	27280	05440	32720	55
6	67303	94553	72750	27250	05447	32697	54
7	67327	94546	72780	27220	05454	32673	53
8	67350	94540	72811	27189	05460	32650	52
9	67374	94533	72841	27159	05467	32626	51
10	9.67398	9.94526	9.72872	10.27128	10.05474	10.32602	50
11	67421	94519	72902	27098	05481	32579	49
12	67445	94513	72932	27068	05487	32555	48
13	67468	94506	72963	27037	05494	32532	47
14	67492	94499	72993	27007	05501	32508	46
15	67515	94492	73023	26977	05508	32485	45
16	67539	94485	73054	26946	05515	32461	44
17	67562	94479	73084	26916	05521	32438	43
18	67586	94472	73114	26886	05528	32414	42
19	67609	94465	73144	26856	05535	32391	41
20	9.67633	9.94458	9.73175	10.26825	10.05542	10.32367	40
21	67656	94451	73205	26795	05549	32344	39
22	67680	94445	73235	26765	05555	32320	38
23	67703	94438	73265	26735	05562	32297	37
24	67726	94431	73295	26705	05569	32274	36
25	67750	94424	73326	26674	05576	32250	35
26	67773	94417	73356	26644	05583	32227	34
27	67796	94410	73386	26614	05590	32204	33
28	67820	94404	73416	26584	05596	32180	32
29	67843	94397	73446	26554	05603	32157	31
30	9.67866	9.94390	9.73476	10.26524	10.05610	10.32134	30
31	67890	94383	73507	26493	05617	32110	29
32	67913	94376	73537	26463	05624	32087	28
33	67936	94369	73567	26433	05631	32064	27
34	67959	94362	73597	26403	05638	32041	26
35	67982	94355	73627	26373	05645	32018	25
36	68006	94349	73657	26343	05651	31994	24
37	68029	94342	73687	26313	05658	31971	23
38	68052	94335	73717	26283	05665	31948	22
39	68075	94328	73747	26253	05672	31925	21
40	9.68098	9.94321	9.73777	10.26223	10.05679	10.31902	20
41	68121	94314	73807	26193	05686	31879	19
42	68144	94307	73837	26163	05693	31856	18
43	68167	94300	73867	26133	05700	31833	17
44	68190	94293	73897	26103	05707	31810	16
45	68213	94286	73927	26073	05714	31787	15
46	68237	94279	73957	26043	05721	31763	14
47	68260	94273	73987	26013	05727	31740	13
48	68282	94266	74017	25983	05734	31718	12
49	68305	94259	74047	25953	05741	31695	11
50	9.68328	9.94252	9.74077	10.25923	10.05748	10.31672	10
51	68351	94245	74107	25893	05755	31649	9
52	68374	94238	74137	25863	05762	31626	8
53	68397	94231	74166	25834	05769	31603	7
54	68420	94224	74196	25804	05776	31580	6
55	68443	94217	74226	25774	05783	31557	5
56	68466	94210	74256	25744	05790	31534	4
57	68489	94203	74286	25714	05797	31511	3
58	68512	94196	74316	25684	05804	31488	2
59	68534	94189	74345	25655	05811	31466	1
60	68557	94182	74375	25625	05818	31443	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-fine.	Tangent.	Co-tang.	Secant.	Co-fecant.	
0	9.68557	9.94182	9.74375	10.25625	10.05818	10.31443	60
1	68580	94175	74405	25595	05825	31420	59
2	68603	94168	74435	25565	05832	31397	58
3	68625	94161	74465	25535	05839	31375	57
4	68648	94154	74494	25506	05846	31352	56
5	68671	94147	74524	25476	05853	31329	55
6	68694	94140	74554	25446	05860	31306	54
7	68716	94133	74583	25417	05867	31284	53
8	68739	94126	74613	25387	05874	31261	52
9	68762	94119	74643	25357	05881	31238	51
10	9.68784	9.94112	9.74673	10.25327	10.05888	10.31216	50
11	68807	94105	74702	25298	05895	31193	49
12	68829	94098	74732	25268	05902	31171	48
13	68852	94090	74762	25238	05910	31148	47
14	68875	94083	74791	25209	05917	31125	46
15	68897	94076	74821	25179	05924	31103	45
16	68920	94069	74851	25149	05931	31080	44
17	68942	94062	74880	25120	05938	31058	43
18	68965	94055	74910	25090	05945	31035	42
19	68987	94048	74939	25061	05952	31013	41
20	9.69010	9.94041	9.74969	10.25031	10.05959	10.30990	40
21	69032	94034	74998	25002	05966	30968	39
22	69055	94027	75028	24972	05973	30945	38
23	69077	94020	75058	24942	05980	30923	37
24	69100	94012	75087	24913	05988	30900	36
25	69122	94005	75117	24883	05995	30878	35
26	69144	93998	75146	24854	06002	30856	34
27	69167	93991	75176	24824	06009	30833	33
28	69189	93984	75205	24795	06016	30811	32
29	69212	93977	75235	24765	06023	30788	31
30	9.69234	9.93970	9.75264	10.24736	10.06030	10.30766	30
31	69256	93963	75294	24706	06037	30744	29
32	69279	93955	75323	24677	06045	30721	28
33	69301	93948	75353	24647	06052	30699	27
34	69323	93941	75382	24618	06059	30677	26
35	69345	93934	75411	24589	06066	30655	25
36	69368	93927	75441	24559	06073	30632	24
37	69390	93920	75470	24530	06080	30610	23
38	69412	93912	75500	24500	06088	30588	22
39	69434	93905	75529	24471	06095	30566	21
40	9.69456	9.93898	9.75558	10.24442	10.06102	10.30544	20
41	69479	93891	75588	24412	06109	30521	19
42	69501	93884	75617	24383	06116	30499	18
43	69523	93876	75647	24353	06124	30477	17
44	69545	93869	75676	24324	06131	30455	16
45	69567	93862	75705	24295	06138	30433	15
46	69589	93855	75735	24265	06145	30411	14
47	69611	93847	75764	24236	06153	30389	13
48	69633	93840	75793	24207	06160	30367	12
49	69655	93833	75822	24178	06167	30345	11
50	9.69677	9.93826	9.75852	10.24148	10.06174	10.30323	10
51	69699	93819	75881	24119	06181	30301	9
52	69721	93811	75910	24090	06189	30279	8
53	69743	93804	75939	24061	06196	30257	7
54	69765	93797	75969	24031	06203	30235	6
55	69787	93789	75998	24002	06211	30213	5
56	69809	93782	76027	23973	06218	30191	4
57	69831	93775	76056	23944	06225	30169	3
58	69853	93768	76086	23914	06232	30147	2
59	69875	93760	76115	23885	06240	30125	1
60	69897	93753	76144	23856	06247	30103	0
	Co-fine.	Sine.	Co-tang.	Tangent.	Co-fecant	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.53405	9.97299	9.56107	10.43893	10.02701	10.46595	60
1	53440	97294	56146	43854	02706	46560	59
2	53475	97289	56185	43815	02711	46525	58
3	53509	97285	56224	43776	02715	46491	57
4	53544	97280	56264	43736	02720	46456	56
5	53578	97276	56303	43697	02724	46422	55
6	53613	97271	56342	43658	02729	46387	54
7	53647	97266	56381	43619	02734	46353	53
8	53682	97262	56420	43580	02738	46318	52
9	53716	97257	56459	43541	02743	46284	51
10	9.53751	9.97252	9.56498	10.43502	10.02748	10.46249	50
11	53785	97248	56537	43463	02752	46215	49
12	53819	97243	56576	43424	02757	46181	48
13	53854	97238	56615	43385	02762	46146	47
14	53888	97234	56654	43346	02766	46112	46
15	53922	97229	56693	43307	02771	46078	45
16	53957	97224	56732	43268	02776	46043	44
17	53991	97220	56771	43229	02780	46009	43
18	54025	97215	56810	43190	02785	45975	42
19	54059	97210	56849	43151	02790	45941	41
20	9.54093	9.97206	9.56887	10.43113	10.02794	10.45907	40
21	54127	97201	56926	43074	02799	45873	39
22	54161	97196	56965	43035	02804	45839	38
23	54195	97192	57004	42996	02808	45805	37
24	54229	97187	57042	42958	02813	45771	36
25	54263	97182	57081	42919	02818	45737	35
26	54297	97178	57120	42880	02822	45703	34
27	54331	97173	57158	42842	02827	45669	33
28	54365	97168	57197	42803	02832	45635	32
29	54399	97163	57235	42765	02837	45601	31
30	9.54433	9.97159	9.57274	10.42726	10.02841	10.45567	30
31	54466	97154	57312	42688	02846	45534	29
32	54500	97149	57351	42649	02851	45500	28
33	54534	97145	57389	42611	02855	45466	27
34	54567	97140	57428	42572	02860	45433	26
35	54601	97135	57466	42534	02865	45399	25
36	54635	97130	57504	42496	02870	45365	24
37	54668	97126	57543	42457	02874	45332	23
38	54702	97121	57581	42419	02879	45298	22
39	54735	97116	57619	42381	02884	45265	21
40	9.54769	9.97111	9.57658	10.42342	10.02889	10.45231	20
41	54802	97107	57696	42304	02893	45198	19
42	54836	97102	57734	42266	02898	45164	18
43	54869	97097	57772	42228	02903	45131	17
44	54903	97092	57810	42190	02908	45097	16
45	54936	97087	57849	42151	02913	45064	15
46	54969	97083	57887	42113	02917	45031	14
47	55003	97078	57925	42075	02922	44997	13
48	55036	97073	57963	42037	02927	44964	12
49	55069	97068	58001	41999	02932	44931	11
50	9.55102	9.97063	9.58039	10.41961	10.02937	10.44898	10
51	55136	97059	58077	41923	02941	44864	9
52	55169	97054	58115	41885	02946	44831	8
53	55202	97049	58153	41847	02951	44798	7
54	55235	97044	58191	41809	02956	44765	6
55	55268	97039	58229	41771	02961	44732	5
56	55301	97035	58267	41733	02965	44699	4
57	55334	97030	58304	41696	02970	44666	3
58	55367	97025	58342	41658	02975	44633	2
59	55400	97020	58380	41620	02980	44600	1
60	55433	97015	58418	41582	02985	44567	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-ſine.	Tangent.	Co-tang.	Secant.	Co-ſecant	
0	9.71184	9.93307	9.77877	10.22123	10.06693	10.28816	60
1	71205	93299	77906	22094	06701	28795	59
2	71226	93291	77935	22065	06709	28774	58
3	71247	93284	77963	22037	06716	28753	57
4	71268	93276	77992	22008	06724	28732	56
5	71289	93269	78020	21980	06731	28711	55
6	71310	93261	78049	21951	06739	28690	54
7	71331	93253	78077	21923	06747	28669	53
8	71352	93246	78106	21894	06754	28648	52
9	71373	93238	78135	21865	06762	28627	51
10	9.71393	9.93230	9.78163	10.21837	10.06770	10.28607	50
11	71414	93223	78192	21808	06777	28586	49
12	71435	93215	78220	21780	06785	28565	48
13	71456	93207	78249	21751	06793	28544	47
14	71477	93200	78277	21723	06800	28523	46
15	71498	93192	78306	21694	06808	28502	45
16	71519	93184	78334	21666	06816	28481	44
17	71539	93177	78363	21637	06823	28461	43
18	71560	93169	78391	21609	06831	28440	42
19	71581	93161	78419	21581	06839	28419	41
20	9.71602	9.93154	9.78448	10.21552	10.06846	10.28398	40
21	71622	93146	78476	21524	06854	28378	39
22	71643	93138	78505	21495	06862	28357	38
23	71664	93131	78533	21467	06869	28336	37
24	71685	93123	78562	21438	06877	28315	36
25	71705	93115	78590	21410	06885	28295	35
26	71726	93108	78618	21382	06892	28274	34
27	71747	93100	78647	21353	06900	28253	33
28	71767	93092	78675	21325	06908	28233	32
29	71788	93084	78704	21296	06916	28222	31
30	9.71809	9.93077	9.78732	10.21268	10.06923	10.28191	30
31	71829	93069	78760	21240	06931	28171	29
32	71850	93061	78789	21211	06939	28150	28
33	71870	93053	78817	21183	06947	28130	27
34	71891	93046	78845	21155	06954	28109	26
35	71911	93038	78874	21126	06962	28089	25
36	71932	93030	78902	21098	06970	28068	24
37	71952	93022	78930	21070	06978	28048	23
38	71973	93014	78959	21041	06986	28027	22
39	71994	93007	78987	21013	06993	28006	21
40	9.72014	9.92999	9.79015	10.20985	10.07001	10.27986	20
41	72034	92991	79043	20957	07009	27966	19
42	72055	92983	79072	20928	07017	27945	18
43	72075	92976	79100	20900	07024	27925	17
44	72096	92968	79128	20872	07032	27904	16
45	72116	92960	79156	20844	07040	27884	15
46	72137	92952	79185	20815	07048	27863	14
47	72157	92944	79213	20787	07056	27843	13
48	72177	92936	79241	20759	07064	27823	12
49	72198	92929	79269	20731	07071	27802	11
50	9.72218	9.92921	9.79297	10.20703	10.07079	10.27782	10
51	72238	92913	79326	20674	07087	27762	9
52	72259	92905	79354	20646	07095	27741	8
53	72279	92897	79382	20618	07103	27721	7
54	72299	92889	79410	20590	07111	27701	6
55	72320	92881	79438	20562	07119	27680	5
56	72340	92874	79466	20534	07126	27660	4
57	72360	92866	79495	20505	07134	27640	3
58	72381	92858	79523	20447	07142	27619	2
59	72401	92850	79551	20449	07150	27599	1
60	72421	92842	79579	20421	07158	27579	0
	Co-ſine.	Sine.	Co-tang.	Tangent.	Co-ſecant	Secant.	M.

M.	Sine.	Co-fine.	Tangent.	Co-tang.	Secant.	Co-fecant.	
0	9.72421	9.92842	9.79579	10.20421	10.07158	10.27579	60
1	72441	92834	79607	20393	07166	27559	59
2	72461	92826	79635	20365	07174	27539	58
3	72482	92818	79663	20337	07182	27518	57
4	72502	92810	79691	20309	07190	27498	56
5	72522	92803	79719	20281	07197	27478	55
6	72542	92795	79747	20253	07205	27458	54
7	72562	92787	79776	20224	07213	27438	53
8	72582	92779	79804	20196	07221	27418	52
9	72602	92771	79832	20168	07229	27398	51
10	9.72622	9.92763	9.79860	10.20140	10.07237	10.27378	50
11	72643	92755	79888	20112	07245	27357	49
12	72663	92747	79916	20084	07253	27337	48
13	72683	92739	79944	20056	07261	27317	47
14	72703	92731	79972	20028	07269	27297	46
15	72723	92723	80000	20000	07277	27277	45
16	72743	92715	80028	19972	07285	27257	44
17	72763	92707	80056	19944	07293	27237	43
18	72783	92699	80084	19916	07301	27217	42
19	72803	92691	80112	19888	07309	27297	41
20	9.72823	9.92683	9.80140	10.19860	10.07317	10.27177	40
21	72843	92675	80168	19832	07325	27157	39
22	72863	92667	80195	19805	07333	27137	38
23	72883	92659	80223	19777	07341	27117	37
24	72902	92651	80251	19749	07349	27098	36
25	72922	92643	80279	19721	07357	27078	35
26	72942	92635	80307	19693	07365	27058	34
27	72962	92627	80335	19665	07373	27038	33
28	72982	92619	80363	19637	07381	27018	32
29	73002	92611	80391	19609	07389	26998	31
30	9.73022	9.92603	9.80419	10.19581	10.07397	10.26978	30
31	73041	92595	80447	19553	07405	26959	29
32	73061	92587	80474	19526	07413	26939	28
33	73081	92579	80502	19498	07421	26919	27
34	73101	92571	80530	19470	07429	26899	26
35	73121	92563	80558	19442	07437	26879	25
36	73140	92555	80586	19414	07445	26860	24
37	73160	92546	80614	19386	07454	26840	23
38	73180	92538	80642	19358	07462	26820	22
39	73200	92530	80669	19331	07470	26800	21
40	9.73219	9.92522	9.80697	10.19303	10.07478	10.26781	20
41	73239	92514	80725	19275	07486	26761	19
42	73259	92506	80753	19247	07494	26741	18
43	73278	92498	80781	19219	07502	26722	17
44	73298	92490	80808	19192	07510	26702	16
45	73318	92482	80836	19164	07518	26682	15
46	73337	92473	80864	19136	07527	26663	14
47	73357	92465	80892	19108	07535	26643	13
48	73377	92457	80919	19081	07543	26623	12
49	73396	92449	80947	19053	07551	26604	11
50	9.73416	9.92441	9.80975	10.19025	10.07559	10.26584	10
51	73435	92433	81003	18997	07567	26565	9
52	73455	92425	81030	18970	07575	26545	8
53	73474	92416	81058	18942	07584	26526	7
54	73494	92408	81086	18914	07592	26506	6
55	73513	92400	81113	18887	07600	26487	5
56	73533	92392	81141	18859	07608	26467	4
57	73552	92384	81169	18831	07616	26448	3
58	73572	92376	81196	18804	07624	26428	2
59	73691	92367	81224	18776	07633	26409	1
60	73611	92359	81252	18748	07641	26389	0
	Co-fine.	Sine.	Co-tang.	Tangent.	Co-fecant.	Secant.	M.

57 Degrees.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.73611	9.92359	9.81252	10.18748	10.07641	10.26389	60
1	73630	92351	81279	18721	07649	26370	59
2	73650	92343	81307	18693	07657	26350	58
3	73669	92334	81335	18665	07666	26331	57
4	73689	92326	81362	18638	07674	26311	56
5	73708	92318	81390	18610	07682	26292	55
6	73727	92310	81418	18582	07690	26273	54
7	73747	92302	81445	18555	07698	26253	53
8	73766	92293	81473	18527	07707	26234	52
9	73785	92285	81500	18500	07715	26215	51
10	9.73805	9.92277	9.81528	10.18472	10.07723	10.26195	50
11	73824	92269	81556	18444	07731	26176	49
12	73843	92260	81583	18417	07740	26157	48
13	73863	92252	81611	18389	07748	26137	47
14	73882	92244	81638	18362	07756	26118	46
15	73901	92235	81666	18334	07765	26099	45
16	73921	92227	81693	18307	07773	26079	44
17	73940	92219	81721	18279	07781	26060	43
18	73959	92211	81748	18252	07789	26041	42
19	73978	92202	81776	18224	07798	26022	41
20	9.73997	9.92194	9.81803	10.18197	10.07806	10.26003	40
21	74017	92186	81831	18169	07814	25983	39
22	74036	92177	81858	18142	07823	25964	38
23	74055	92169	81886	18114	07831	25945	37
24	74074	92161	81913	18087	07839	25926	36
25	74093	92152	81941	18059	07848	25907	35
26	74113	92144	81968	18032	07856	25887	34
27	74132	92136	81996	18004	07864	25868	33
28	74151	92127	82023	17977	07873	25849	32
29	74170	92119	82051	17949	07881	25830	31
30	9.74189	9.92111	9.82078	10.17922	10.07889	10.25811	30
31	74208	92102	82106	17894	07898	25792	29
32	74227	92094	82133	17867	07906	25773	28
33	74246	92086	82161	17839	07914	25754	27
34	74265	92077	82188	17812	07923	25735	26
35	74284	92069	82215	17785	07931	25716	25
36	74303	92060	82243	17757	07940	25697	24
37	74322	92052	82270	17730	07948	25678	23
38	74341	92044	82298	17702	07956	25659	22
39	74360	92035	82325	17675	07965	25640	21
40	9.74379	9.92027	9.82352	10.17648	10.07973	10.25621	20
41	74398	92018	82380	17620	07982	25602	19
42	74417	92010	82407	17593	07990	25583	18
43	74436	92002	82435	17565	07998	25564	17
44	74455	91993	82462	17538	08007	25545	16
45	74474	91985	82489	17511	08015	25526	15
46	74493	91976	82517	17483	08024	25507	14
47	74512	91968	82544	17456	08032	25488	13
48	74531	91959	82571	17429	08041	25469	12
49	74549	91951	82599	17401	08049	25451	11
50	9.74568	9.91942	9.82626	10.17374	10.08058	10.25432	10
51	74587	91934	82653	17347	08066	25413	9
52	74606	91925	82681	17319	08075	25394	8
53	74625	91917	82708	17292	08083	25375	7
54	74644	91908	82735	17265	08092	25356	6
55	74662	91900	82762	17238	08100	25338	5
56	74681	91891	82790	17210	08109	25319	4
57	74700	91883	82817	17183	08117	25300	3
58	74719	91874	82844	17156	08126	25281	2
59	74737	91866	82871	17129	08134	25263	1
60	74756	91857	82899	17101	08143	25244	0
	Co-sine.	Sine.	Co-tang.	Tangent	Co-secant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.74756	9.91857	9.82899	10.17101	10.08143	10.25244	60
1	74775	91849	82926	17074	08151	25225	59
2	74794	91840	82953	17047	08160	25206	58
3	74812	91832	82980	17020	08168	25188	57
4	74831	91823	83008	16992	08177	25169	56
5	74850	91815	83035	16965	08185	25150	55
6	74868	91806	83062	16938	08194	25132	54
7	74887	91798	83089	16911	08202	25113	53
8	74906	91789	83117	16883	08211	25094	52
9	74924	91781	83144	16856	08219	25076	51
10	9.74943	9.91772	9.83171	10.16829	10.08228	10.25057	50
11	74961	91763	83198	16802	08237	25039	49
12	74980	91755	83225	16775	08245	25020	48
13	74999	91746	83252	16748	08254	25001	47
14	75017	91738	83280	16720	08262	24983	46
15	75036	91729	83307	16693	08271	24964	45
16	75054	91720	83334	16666	08280	24946	44
17	75073	91712	83361	16639	08288	24927	43
18	75091	91703	83388	16612	08297	24909	42
19	75110	91695	83415	16585	08305	24890	41
20	9.75128	9.91686	9.83442	10.16558	10.08314	10.24872	40
21	75147	91677	83470	16530	08323	24853	39
22	75165	91669	83497	16503	08331	24835	38
23	75184	91660	83524	16476	08340	24816	37
24	75202	91651	83551	16449	08349	24798	36
25	75221	91643	83578	16422	08357	24779	35
26	75239	91634	83605	16395	08366	24761	34
27	75258	91625	83632	16368	08375	24742	33
28	75276	91617	83659	16341	08383	24724	32
29	75294	91608	83686	16314	08392	24706	31
30	9.75313	9.91599	9.83713	10.16287	10.08401	10.24687	30
31	75331	91591	83740	16260	08409	24669	29
32	75350	91582	83768	16232	08418	24650	28
33	75368	91573	83795	16205	08427	24632	27
34	75386	91565	83822	16178	08435	24614	26
35	75405	91556	83849	16151	08444	24595	25
36	75423	91547	83876	16124	08453	24577	24
37	75441	91538	83903	16097	08462	24559	23
38	75459	91530	83930	16070	08470	24541	22
39	75478	91521	83957	16043	08479	24522	21
40	9.75496	9.91512	9.83984	10.16016	10.08488	10.24504	20
41	75514	91504	84011	15989	08496	24486	19
42	75533	91495	84038	15962	08505	24467	18
43	75551	91486	84065	15935	08514	24449	17
44	75569	91477	84092	15908	08523	24431	16
45	75587	91469	84119	15881	08531	24413	15
46	75605	91460	84146	15854	08540	24395	14
47	75624	91451	84173	15827	08549	24376	13
48	75642	91442	84200	15800	08558	24358	12
49	75660	91433	84227	15773	08567	24340	11
50	9.75678	9.91425	9.84254	10.15746	10.08575	10.24322	10
51	75696	91416	84280	15720	08584	24304	9
52	75714	91407	84307	15693	08593	24286	8
53	75733	91398	84334	15666	08602	24267	7
54	75751	91389	84361	15639	08611	24249	6
55	75769	91381	84388	15612	08619	24231	5
56	75787	91372	84415	15585	08628	24213	4
57	75805	91363	84442	15558	08637	24195	3
58	75823	91354	84469	15531	08646	24177	2
59	75841	91345	84496	15504	08655	24159	1
60	75859	91336	84523	15477	08664	24141	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-fine.	Tangent.	Co-tang.	Secant.	Co-fecant.	
0	9.62595	95728	9.66867	10.33133	10.04272	10.37405	60
1	62622	95722	66900	33100	04278	37378	59
2	62649	95716	66933	33067	04284	37351	58
3	62676	95710	66966	33034	04290	37324	57
4	62703	95704	66999	33001	04296	37297	56
5	62730	95698	67032	32968	04302	37270	55
6	62757	95692	67065	32935	04308	37243	54
7	62784	95686	67098	32902	04314	37216	53
8	62811	95680	67131	32869	04320	37189	52
9	62838	95674	67163	32837	04326	37162	51
10	9.62865	9.95668	9.67196	10.32804	10.04332	10.37135	50
11	62892	95663	67229	32771	04337	37108	49
12	62918	95657	67262	32738	04343	37082	48
13	62945	95651	67295	32705	04349	37055	47
14	62972	95645	67327	32673	04355	37028	46
15	62999	95639	67360	32640	04361	37001	45
16	63026	95633	67393	32607	04367	36974	44
17	63052	95627	67426	32574	04373	36948	43
18	63079	95621	67458	32542	04379	36921	42
19	63106	95615	67491	32509	04385	36894	41
20	9.63133	9.95609	9.67524	10.32476	10.04391	10.36867	40
21	63159	95603	67556	32444	04397	36841	39
22	63186	95597	67589	32411	04403	36814	38
23	63213	95591	67622	32378	04409	36787	37
24	63239	95585	67654	32346	04415	36761	36
25	63266	95579	67687	32313	04421	36734	35
26	63292	95573	67719	32281	04427	36708	34
27	63319	95567	67752	32248	04433	36681	33
28	63345	95561	67785	32215	04439	36655	32
29	63372	95555	67817	32183	04445	36628	31
30	9.63398	9.95549	9.67850	10.32150	10.04451	10.36602	30
31	63425	95543	67882	32118	04457	36575	29
32	63451	95537	67915	32085	04463	36549	28
33	63478	95531	67947	32053	04469	36522	27
34	63504	95525	67980	32020	04475	36496	26
35	63531	95519	68012	31988	04481	36469	25
36	63557	95513	68044	31956	04487	36443	24
37	63583	95507	68077	31923	04493	36417	23
38	63610	95500	68109	31891	04500	36390	22
39	63636	95494	68142	31858	04506	36364	21
40	9.63662	9.95488	9.68174	10.31826	10.04512	10.36338	20
41	63689	95482	68206	31794	04518	36311	19
42	63715	95476	68239	31761	04524	36285	18
43	63741	95470	68271	31729	04530	36259	17
44	63767	95464	68303	31697	04536	36233	16
45	63794	95458	68336	31664	04542	36206	15
46	63820	95452	68368	31632	04548	36180	14
47	63846	95446	68400	31600	04554	36154	13
48	63872	95440	68432	31568	04560	36128	12
49	63898	95434	68465	31535	04566	36102	11
50	9.63924	9.95427	9.68497	10.31503	10.04573	10.36076	10
51	63950	95421	68529	31471	04579	36050	9
52	63976	95415	68561	31439	04585	36024	8
53	64002	95409	68593	31407	04591	35998	7
54	64028	95403	68626	31374	04597	35972	6
55	64054	95397	68658	31342	04603	35946	5
56	64080	95391	68690	31310	04609	35920	4
57	64106	95384	68722	31278	04616	35894	3
58	64132	95378	68754	31246	04622	35868	2
59	64158	95372	68786	31214	04628	35842	1
60	64184	95366	68818	31182	04634	35816	0
	Co fine.	Sine.	Co tang.	Tangent.	Co-fecant.	Secant.	M.

M.	Sine.	Co-fine.	Tangent.	Co-tang.	Secant.	Co-fecant	
0	9.64184	9.95366	9.68818	10.31182	10.04634	10.35816	60
1	64210	95360	68850	31150	04640	35790	59
2	64236	95354	68882	31118	04646	35764	58
3	64262	95348	68914	31086	04652	35738	57
4	64288	95341	68946	31054	04659	35712	56
5	64313	95335	68978	31022	04665	35687	55
6	64339	95329	69010	30990	04671	35661	54
7	64365	95323	69042	30958	04677	35635	53
8	64391	95317	69074	30926	04683	35609	52
9	64417	95310	69106	30894	04690	35583	51
10	9.64442	9.95304	9.69138	10.30862	10.04696	10.35558	50
11	64468	95298	69170	30830	04702	35532	49
12	64494	95292	69202	30798	04708	35506	48
13	64519	95286	69234	30766	04714	35481	47
14	64545	95279	69266	30734	04721	35455	46
15	64571	95273	69298	30702	04727	35429	45
16	64596	95267	69329	30671	04733	35404	44
17	64622	95261	69361	30639	04739	35378	43
18	64647	95254	69393	30607	04746	35353	42
19	64673	95248	69425	30575	04752	35327	41
20	9.64698	9.95242	9.69457	10.30543	10.04758	10.35302	40
21	64724	95236	69488	30512	04764	35276	39
22	64749	95229	69520	30480	04771	35251	38
23	64775	95223	69552	30448	04777	35225	37
24	64800	95217	69584	30416	04783	35200	36
25	64826	95211	69615	30385	04789	35174	35
26	64851	95204	69647	30353	04796	35149	34
27	64877	95198	69679	30321	04802	35123	33
28	64902	95192	69710	30290	04808	35098	32
29	64927	95185	69742	30258	04815	35073	31
30	9.64953	9.95179	9.69774	10.30226	10.04821	10.35047	30
31	64978	95173	69805	30195	04827	35022	29
32	65003	95167	69837	30163	04833	34997	28
33	65029	95160	69868	30132	04840	34971	27
34	65054	95154	69900	30100	04846	34946	26
35	65079	95148	69932	30068	04852	34921	25
36	65104	95141	69963	30037	04859	34896	24
37	65130	95135	69995	30005	04865	34870	23
38	65155	95129	70026	29974	04871	34845	22
39	65180	95122	70058	29942	04878	34820	21
40	9.65205	9.95116	9.70089	10.29911	10.04884	10.34795	20
41	65230	95110	70121	29879	04890	34770	19
42	65255	95103	70152	29848	04897	34745	18
43	65281	95097	70184	29816	04903	34719	17
44	65306	95090	70215	29785	04910	34694	16
45	65331	95084	70247	29753	04916	34669	15
46	65356	95078	70278	29722	04922	34644	14
47	65381	95071	70309	29691	04929	34619	13
48	65406	95065	70341	29659	04935	34594	12
49	65431	95059	70372	29628	04941	34569	11
50	9.65456	9.95052	9.70404	10.29596	10.04948	10.34544	10
51	65481	95046	70435	29565	04954	34519	9
52	65506	95039	70466	29534	04961	34494	8
53	65531	95033	70498	29502	04967	34469	7
54	65556	95027	70529	29471	04973	34444	6
55	65580	95020	70560	29440	04980	34420	5
56	65605	95014	70592	29408	04986	34395	4
57	65630	95007	70623	29377	04993	34370	3
58	65655	95001	70654	29346	04999	34345	2
59	65680	94995	70685	29315	05005	34320	1
60	65705	94988	70717	29283	05012	34295	0
	Co-fine.	Sine.	Co-tang.	Tangent.	Co fecant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant	
0	9.65705	9.94988	9.70717	10.29283	10.05012	10.34295	60
1	65729	94982	70748	29252	05018	34271	59
2	65754	94975	70779	29221	05025	34246	58
3	65779	94969	70810	29190	05031	34221	57
4	65804	94962	70841	29159	05038	34196	56
5	65828	94956	70873	29127	05044	34172	55
6	65853	94949	70904	29096	05051	34147	54
7	65878	94943	70935	29065	05057	34122	53
8	65902	94936	70966	29034	05064	34098	52
9	65927	94930	70997	29003	05070	34073	51
10	9.65952	9.94923	9.71028	10.28972	10.05077	10.34048	50
11	65976	94917	71059	28941	05083	34024	49
12	66001	94911	71090	28910	05089	33999	48
13	66025	94904	71121	28879	05096	33975	47
14	66050	94898	71153	28847	05102	33950	46
15	66075	94891	71184	28816	05109	33925	45
16	66099	94885	71215	28785	05115	33901	44
17	66124	94878	71246	28754	05122	33876	43
18	66148	94871	71277	28723	05129	33852	42
19	66173	94865	71308	28692	05135	33827	41
20	9.66197	9.94858	9.71339	10.28661	10.05142	10.33803	40
21	66221	94852	71370	28630	05148	33779	39
22	66246	94845	71401	28599	05155	33754	38
23	66270	94839	71431	28569	05161	33730	37
24	66295	94832	71462	28538	05168	33705	36
25	66319	94826	71493	28507	05174	33681	35
26	66343	94819	71524	28476	05181	33657	34
27	66368	94813	71555	28445	05187	33632	33
28	66392	94806	71586	28414	05194	33608	32
29	66416	94799	71617	28383	05201	33584	31
30	9.66441	9.94793	9.71648	10.28352	10.05207	10.33559	30
31	66465	94786	71679	28321	05214	33535	29
32	66489	94780	71709	28291	05220	33511	28
33	66513	94773	71740	28260	05227	33487	27
34	66537	94767	71771	28229	05233	33463	26
35	66562	94760	71802	28198	05240	33438	25
36	66586	94753	71833	28167	05247	33414	24
37	66610	94747	71863	28137	05253	33390	23
38	66634	94740	71894	28106	05260	33366	22
39	66658	94734	71925	28075	05266	33342	21
40	9.66682	9.94727	9.71955	10.28045	10.05273	10.33318	20
41	66706	94720	71986	28014	05280	33294	19
42	66731	94714	72017	27983	05286	33269	18
43	66755	94707	72048	27952	05293	33245	17
44	66779	94700	72078	27922	05300	33221	16
45	66803	94694	72109	27891	05306	33197	15
46	66827	94687	72140	27860	05313	33173	14
47	66851	94680	72170	27830	05320	33149	13
48	66875	94674	72201	27799	05326	33125	12
49	66899	94667	72231	27769	05333	33101	11
50	9.66922	9.94660	9.72262	10.27738	10.05340	10.33078	10
51	66946	94654	72293	27707	05346	33054	9
52	66970	94647	72323	27677	05353	33030	8
53	66994	94640	72354	27646	05360	33006	7
54	67018	94634	72384	27616	05366	32982	6
55	67042	94627	72415	27585	05373	32958	5
56	67066	94620	72445	27555	05380	32934	4
57	67090	94614	72476	27524	05386	32910	3
58	67113	94607	72506	27494	05393	32887	2
59	67137	94600	72537	27463	05400	32863	1
60	67161	94593	72567	27433	05407	32839	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-fine.	Tangent.	Co-tang.	Secant.	Co-fecant.	
0	9.67161	9.94593	9.72567	10.27433	10.05407	10.32839	60
1	67185	94587	72598	27402	05413	32815	59
2	67208	94580	72628	27372	05420	32792	58
3	67232	94573	72659	27341	05427	32768	57
4	67256	94567	72689	27311	05433	32744	56
5	67280	94560	72720	27280	05440	32720	55
6	67303	94553	72750	27250	05447	32697	54
7	67327	94546	72780	27220	05454	32673	53
8	67350	94540	72811	27189	05460	32650	52
9	67374	94533	72841	27159	05467	32626	51
10	9.67398	9..4526	9.72872	10.27128	10.05474	10.32602	50
11	67421	94519	72902	27098	05481	32579	49
12	67445	94513	72932	27068	05487	32555	48
13	67468	94506	72963	27037	05494	32532	47
14	67492	94499	72993	27007	05501	32508	46
15	67515	94492	73023	26977	05508	32485	45
16	67539	94485	73054	26946	05515	32461	44
17	67562	94479	73084	26916	05521	32438	43
18	67586	94472	73114	26886	05528	32414	42
19	67609	94465	73144	26856	05535	32391	41
20	9.67633	9.94458	9.73175	10.26825	10.05542	10.32367	40
21	67656	94451	73205	26795	05549	32344	39
22	67680	94445	73235	26765	05555	32320	38
23	67703	94438	73265	26735	05562	32297	37
24	67726	94431	73295	26705	05569	32274	36
25	67750	94424	73326	26674	05576	32250	35
26	67773	94417	73356	26644	05583	32227	34
27	67796	94410	73386	26614	05590	32204	33
28	67820	94404	73416	26584	05596	32180	32
29	67843	94397	73446	26554	05603	32157	31
30	9.67866	9.94390	9.73476	10.26524	10.05610	10.32134	30
31	67890	94383	73507	26493	05617	32110	29
32	67913	74376	73537	26463	05624	32087	28
33	67936	94369	73567	26433	05631	32064	27
34	67959	94362	73597	26403	05638	32041	26
35	67982	94355	73627	26373	05645	32018	25
36	68006	94349	73657	26343	05651	31994	24
37	68029	94342	73687	26313	05658	31971	23
38	68052	94335	73717	26283	05665	31948	22
39	68075	94328	73747	26253	05672	31925	21
40	9.68098	9.94321	9.73777	10.26223	10.05679	10.31902	20
41	68121	94314	73807	26193	05686	31879	19
42	68144	94307	73837	26163	05693	31856	18
43	68167	94300	73867	26133	05700	31833	17
44	68190	94293	73897	26103	05707	31810	16
45	68213	94286	73927	26073	05714	31787	15
46	68237	94279	73957	26043	05721	31763	14
47	68260	94273	73987	26013	05727	31740	13
48	68282	94266	74017	25983	05734	31718	12
49	68305	94259	74047	25953	05741	31695	11
50	9.68328	9.94252	9.74077	10.25923	10.05748	10.31672	10
51	68351	94245	74107	25893	05755	31649	9
52	68374	94238	74137	25863	05762	31626	8
53	68397	94231	74166	25834	05769	31603	7
54	68420	94224	74196	25804	05776	31580	6
55	68443	94217	74226	25774	05783	31557	5
56	68466	94210	74256	25744	05790	31534	4
57	68489	94203	74286	25714	05797	31511	3
58	68512	94196	74316	25684	05804	31488	2
59	68534	94189	74345	25655	05811	31466	1
60	68557	94182	74375	25625	05818	31443	0
	Co-fine.	Sine.	Co-tang.	Tangent.	Co-fecant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.68557	9.94182	9.74375	10.25625	10.05818	10.31443	60
1	68580	94175	74405	25595	05825	31420	59
2	68603	94168	74435	25565	05832	31397	58
3	68625	94161	74465	25535	05839	31375	57
4	68648	94154	74494	25506	05846	31352	56
5	68671	94147	74524	25476	05853	31329	55
6	68694	94140	74554	25446	05860	31306	54
7	68716	94133	74583	25417	05867	31284	53
8	68739	94126	74613	25387	05874	31261	52
9	68762	94119	74643	25357	05881	31238	51
10	9.68784	9.94112	9.74673	10.25327	10.05888	10.31216	50
11	68807	94105	74702	25298	05895	31193	49
12	68829	94098	74732	25268	05902	31171	48
13	68852	94090	74762	25238	05910	31148	47
14	68875	94083	74791	25209	05917	31125	46
15	68897	94076	74821	25179	05924	31103	45
16	68920	94069	74851	25149	05931	31080	44
17	68942	94062	74880	25120	05938	31058	43
18	68965	94055	74910	25090	05945	31035	42
19	68987	94048	74939	25061	05952	31013	41
20	9.69010	9.94041	9.74969	10.25031	10.05959	10.30990	40
21	69032	94034	74998	25002	05966	30968	39
22	69055	94027	75028	24972	05973	30945	38
23	69077	94020	75058	24942	05980	30923	37
24	69100	94012	75087	24913	05988	30900	36
25	69122	94005	75117	24883	05995	30878	35
26	69144	93998	75146	24854	06002	30856	34
27	69167	93991	75176	24824	06009	30833	33
28	69189	93984	75205	24795	06016	30811	32
29	69212	93977	75235	24765	06023	30788	31
30	9.69234	9.93970	9.75264	10.24736	10.06030	10.30766	30
31	69256	93963	75294	24706	06037	30744	29
32	69279	93955	75323	24677	06045	30721	28
33	69301	93948	75353	24647	06052	30699	27
34	69323	93941	75382	24618	06059	30677	26
35	69345	93934	75411	24589	06066	30655	25
36	69368	93927	75441	24559	06073	30632	24
37	69390	93920	75470	24530	06080	30610	23
38	69412	93912	75500	24500	06088	30588	22
39	69434	93905	75529	24471	06095	30566	21
40	9.69456	9.93898	9.75558	10.24442	10.06102	10.30544	20
41	69479	93891	75588	24412	06109	30521	19
42	69501	93884	75617	24383	06116	30499	18
43	69523	93876	75647	24353	06124	30477	17
44	69545	93869	75676	24324	06131	30455	16
45	69567	93862	75705	24295	06138	30433	15
46	69589	93855	75735	24265	06145	30411	14
47	69611	93847	75764	24236	06153	30389	13
48	69633	93840	75793	24207	06160	30367	12
49	69655	93833	75822	24178	06167	30345	11
50	9.69677	9.93826	9.75852	10.24148	10.06174	10.30323	10
51	69699	93819	75881	24119	06181	30301	9
52	69721	93811	75910	24090	06189	30279	8
53	69743	93804	75939	24061	06196	30257	7
54	69765	93797	75969	24031	06203	30235	6
55	69787	93789	75998	24002	06211	30213	5
56	69809	93782	76027	23973	06218	30191	4
57	69831	93775	76056	23944	06225	30169	3
58	69853	93768	76086	23914	06232	30147	2
59	69875	93760	76115	23885	06240	30125	1
60	69897	93753	76144	23856	06247	30103	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.69897	9.93753	9.76144	10.23856	10.06247	10.30103	60
1	69919	93746	76173	23827	06254	30081	59
2	69941	93738	76202	23798	06262	30059	58
3	69963	93731	76231	23769	06269	30037	57
4	69984	93724	76261	23739	06276	30016	56
5	70006	93717	76290	23710	06283	29994	55
6	70028	93709	76319	23681	06291	29972	54
7	70050	93702	76348	23652	06298	29950	53
8	70072	93695	76377	23623	06305	29928	52
9	70093	93687	76406	23594	06313	29907	51
10	9.70115	9.93680	9.76435	10.23565	10.06320	10.29885	50
11	70137	93673	76464	23536	06327	29863	49
12	70159	93665	76493	23507	06335	29841	48
13	70180	93658	76522	23478	06342	29820	47
14	70202	93650	76551	23449	06350	29798	46
15	70224	93643	76580	23420	06357	29776	45
16	70245	93636	76609	23391	06364	29755	44
17	70267	93628	76639	23361	06372	29733	43
18	70288	93621	76668	23332	06379	29712	42
19	70310	93614	76697	23303	06386	29690	41
20	9.70332	9.93606	9.76725	10.23275	10.06394	10.29668	40
21	70353	93599	76754	23246	06401	29647	39
22	70375	93591	76783	23217	06409	29625	38
23	70396	93584	76812	23188	06416	29604	37
24	70418	93577	76841	23159	06423	29582	36
25	70439	93569	76870	23130	06431	29561	35
26	70461	93562	76899	23101	06438	29539	34
27	70482	93554	76928	23072	06446	29518	33
28	70504	93547	76957	23043	06453	29496	32
29	70525	93539	76986	23014	06461	29475	31
30	9.70547	9.93532	9.77015	10.22985	10.06468	10.29453	30
31	70568	93525	77044	22956	06475	29432	29
32	70590	93517	77073	22927	06483	29410	28
33	70611	93510	77101	22899	06490	29389	27
34	70633	93502	77130	22870	06498	29367	26
35	70654	93495	77159	22841	06505	29346	25
36	70675	93487	77188	22812	06513	29325	24
37	70697	93480	77217	22783	06520	29303	23
38	70718	93472	77246	22754	06528	29282	22
39	70739	93465	77274	22726	06535	29261	21
40	9.70761	9.93457	9.77303	10.22697	10.06543	10.29239	20
41	70782	93450	77332	22668	06550	29218	19
42	70803	93442	77361	22639	06558	29197	18
43	70824	93435	77390	22610	06565	29176	17
44	70846	93427	77418	22582	06573	29154	16
45	70867	93420	77447	22553	06580	29133	15
46	70888	93412	77476	22524	06588	29112	14
47	70909	93405	77505	22495	06595	29091	13
48	70931	93397	77533	22467	06603	29069	12
49	70952	93390	77562	22438	06610	29048	11
50	9.70973	9.93382	9.77591	10.22409	10.06618	10.29027	10
51	70994	93375	77619	22381	06625	29006	9
52	71015	93367	77648	22352	06633	28985	8
53	71036	93360	77677	22323	06640	28964	7
54	71058	93352	77706	22294	06648	28942	6
55	71079	93344	77734	22266	06656	28921	5
56	71100	93337	77763	22237	06663	28900	4
57	71121	93329	77791	22209	06671	28879	3
58	71142	93322	77820	22180	06678	28858	2
59	71163	93314	77849	22151	06686	28837	1
60	71184	93307	77877	22123	06693	28816	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-fine.	Tangent.	Co-tang.	Secant.	Co-fecant	
0	9.71184	9.93307	9.77877	10.22123	10.06693	10.28816	60
1	71205	93299	77906	22094	06701	28795	59
2	71226	93291	77935	22065	06709	28774	58
3	71247	93284	77963	22037	06716	28753	57
4	71268	93276	77992	22008	06724	28732	56
5	71289	93269	78020	21980	06731	28711	55
6	71310	93261	78049	21951	06739	28690	54
7	71331	93253	78077	21923	06747	28669	53
8	71352	93246	78106	21894	06754	28648	52
9	71373	93238	78135	21865	06762	28627	51
10	9.71393	9.93230	9.78163	10.21837	10.06770	10.28607	50
11	71414	93223	78192	21808	06777	28586	49
12	71435	93215	78220	21780	06785	28565	48
13	71456	93207	78249	21751	06793	28544	47
14	71477	93200	78277	21723	06800	28523	46
15	71498	93192	78306	21694	06808	28502	45
16	71519	93184	78334	21666	06816	28481	44
17	71539	93177	78363	21637	06823	28461	43
18	71560	93169	78391	21609	06831	28440	42
19	71581	93161	78419	21581	06839	28419	41
20	9.71602	9.93154	9.78448	10.21552	10.06846	10.28398	40
21	71622	93146	78476	21524	06854	28378	39
22	71643	93138	78505	21495	06862	28357	38
23	71664	93131	78533	21467	06869	28336	37
24	71685	93123	78562	21438	06877	28315	36
25	71705	93115	78590	21410	06885	28295	35
26	71726	93108	78618	21382	06892	28274	34
27	71747	93100	78647	21353	06900	28253	33
28	71767	93092	78675	21325	06908	28233	32
29	71788	93084	78704	21296	06916	28222	31
30	9.71809	9.93077	9.78732	10.21268	10.06923	10.28191	30
31	71829	93069	78760	21240	06931	28171	29
32	71850	93061	78789	21211	06939	28150	28
33	71870	93053	78817	21183	06947	28130	27
34	71891	93046	78845	21155	06954	28109	26
35	71911	93038	78874	21126	06962	28089	25
36	71932	93030	78902	21098	06970	28068	24
37	71952	93022	78930	21070	06978	28048	23
38	71973	93014	78959	21041	06986	28027	22
39	71994	93007	78987	21013	06993	28006	21
40	9.72014	9.92999	9.79015	10.20985	10.07001	10.27986	20
41	72034	92991	79043	20957	07009	27966	19
42	72055	92983	79072	20928	07017	27945	18
43	72075	92976	79100	20900	07024	27925	17
44	72096	92968	79128	20872	07032	27904	16
45	72116	92960	79156	20844	07040	27884	15
46	72137	92952	79185	20815	07048	27863	14
47	72157	92944	79213	20787	07056	27843	13
48	72177	92936	79241	20759	07064	27823	12
49	72198	92929	79269	20731	07071	27802	11
50	9.72218	9.92921	9.79297	10.20703	10.07079	10.27782	10
51	72238	92913	79326	20674	07087	27762	9
52	72259	92905	79354	20646	07095	27741	8
53	72279	92897	79382	20618	07103	27721	7
54	72299	92889	79410	20590	07111	27701	6
55	72320	92881	79438	20562	07119	27680	5
56	72340	92874	79466	20534	07126	27660	4
57	72360	92866	79495	20505	07134	27640	3
58	72381	92858	79523	20447	07142	27619	2
59	72401	92850	79551	20449	07150	27599	1
60	72421	92842	79579	20421	07158	25779	0
	Co-fine.	Sine.	Co-tang.	Tangent.	Co-fecant	Secant.	M.

M.	Sine.	Co-fine.	Tangent.	Co-tang.	Secant.	Co-fecant.	
0	9.69897	9.93753	9.76144	10.23856	10.06247	10.30103	60
1	69919	93746	76173	23827	06254	30081	59
2	69941	93738	76202	23798	06262	30059	58
3	69963	93731	76231	23769	06269	30037	57
4	69984	93724	76261	23739	06276	30016	56
5	70006	93717	76290	23710	06283	29994	55
6	70028	93709	76319	23681	06291	29972	54
7	70050	93702	76348	23652	06298	29950	53
8	70072	93695	76377	23623	06305	29928	52
9	70093	93687	76406	23594	06313	29907	51
10	9.70115	9.93680	9.76435	10.23565	10.06320	10.29885	50
11	70137	93673	76464	23536	06327	29863	49
12	70159	93665	76493	23507	06335	29841	48
13	70180	93658	76522	23478	06342	29820	47
14	70202	93650	76551	23449	06350	29798	46
15	70224	93643	76580	23420	06357	29776	45
16	70245	93636	76609	23391	06364	29755	44
17	70267	93628	76639	23361	06372	29733	43
18	70288	93621	76668	23332	06379	29712	42
19	70310	93614	76697	23303	06386	29690	41
20	9.70332	9.93606	9.76725	10.23275	10.06394	10.29668	40
21	70353	93599	76754	23246	06401	29647	39
22	70375	93591	76783	23217	06409	29625	38
23	70396	93584	76812	23188	06416	29604	37
24	70418	93577	76841	23159	06423	29582	36
25	70439	93569	76870	23130	06431	29561	35
26	70461	93562	76899	23101	06438	29539	34
27	70482	93554	76928	23072	06446	29518	33
28	70504	93547	76957	23043	06453	29496	32
29	70525	93539	76986	23014	06461	29475	31
30	9.70547	9.93532	9.77015	10.22985	10.06468	10.29453	30
31	70568	93525	77044	22956	06475	29432	29
32	70590	93517	77073	22927	06483	29410	28
33	70611	93510	77101	22899	06490	29389	27
34	70633	93502	77130	22870	06498	29367	26
35	70654	93495	77159	22841	06505	29346	25
36	70675	93487	77188	22812	06513	29325	24
37	70697	93480	77217	22783	06520	29303	23
38	70718	93472	77246	22754	06528	29282	22
39	70739	93465	77274	22726	06535	29261	21
40	9.70761	9.93457	9.77303	10.22697	10.06543	10.29239	20
41	70782	93450	77332	22668	06550	29218	19
42	70803	93442	77361	22639	06558	29197	18
43	70824	93435	77390	22610	06565	29176	17
44	70846	93427	77418	22582	06573	29154	16
45	70867	93420	77447	22553	06580	29133	15
46	70888	93412	77476	22524	06588	29112	14
47	70909	93405	77505	22495	06595	29091	13
48	70931	93397	77533	22467	06603	29069	12
49	70952	93390	77562	22438	06610	29048	11
50	9.70973	9.93382	9.77591	10.22409	10.06618	10.29027	10
51	70994	93375	77619	22381	06625	29006	9
52	71015	93367	77648	22352	06633	28985	8
53	71036	93360	77677	22323	06640	28964	7
54	71058	93352	77706	22294	06648	28942	6
55	71079	93344	77734	22266	06656	28921	5
56	71100	93337	77763	22237	06663	28900	4
57	71121	93329	77791	22209	06671	28879	3
58	71142	93322	77820	22180	06678	28858	2
59	71163	93314	77849	22151	06686	28837	1
60	71184	93307	77877	22123	06693	28816	0
	Co fine.	Sine.	Co-tang.	Tangent.	Co-fecant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.73611	9.92359	9.81252	10.18748	10.07641	10.26389	60
1	73630	92351	81279	18721	07649	26370	59
2	73650	92343	81307	18693	07657	26350	58
3	73669	92334	81335	18665	07666	26331	57
4	73689	92326	81362	18638	07674	26311	56
5	73708	92318	81390	18610	07682	26292	55
6	73727	92310	81418	18582	07690	26273	54
7	73747	92302	81445	18555	07698	26253	53
8	73766	92293	81473	18527	07707	26234	52
9	73785	92285	81500	18500	07715	26215	51
10	9.73805	9.92277	9.81528	10.18472	10.07723	10.26195	50
11	73824	92269	81556	18444	07731	26176	49
12	73843	92260	81583	18417	07740	26157	48
13	73863	92252	81611	18389	07748	26137	47
14	73882	92244	81638	18362	07756	26118	46
15	73901	92235	81666	18334	07765	26099	45
16	73921	92227	81693	18307	07773	26079	44
17	73940	92219	81721	18279	07781	26060	43
18	73959	92211	81748	18252	07789	26041	42
19	73978	92202	81776	18224	07798	26022	41
20	9.73997	9.92194	9.81803	10.18197	10.07806	10.26003	40
21	74017	92186	81831	18169	07814	25983	39
22	74036	92177	81858	18142	07823	25964	38
23	74055	92169	81886	18114	07831	25945	37
24	74074	92161	81913	18087	07839	25926	36
25	74093	92152	81941	18059	07848	25907	35
26	74113	92144	81968	18032	07856	25887	34
27	74132	92136	81996	18004	07864	25868	33
28	74151	92127	82023	17977	07873	25849	32
29	74170	92119	82051	17949	07881	25830	31
30	9.74189	9.92111	9.82078	10.17922	10.07889	10.25811	30
31	74208	92102	82106	17894	07898	25792	29
32	74227	92094	82133	17867	07906	25773	28
33	74246	92086	82161	17839	07914	25754	27
34	74265	92077	82188	17812	07923	25735	26
35	74284	92069	82215	17785	07931	25716	25
36	74303	92060	82243	17757	07940	25697	24
37	74322	92052	82270	17730	07948	25678	23
38	74341	92044	82298	17702	07956	25659	22
39	74360	92035	82325	17675	07965	25640	21
40	9.74379	9.92027	9.82352	10.17648	10.07973	10.25621	20
41	74398	92018	82380	17620	07982	25602	19
42	74417	92010	82407	17593	07990	25583	18
43	74436	92002	82435	17565	07998	25564	17
44	74455	91993	82462	17538	08007	25545	16
45	74474	91985	82489	17511	08015	25526	15
46	74493	91976	82517	17483	08024	25507	14
47	74512	91968	82544	17456	08032	25488	13
48	74531	91959	82571	17429	08041	25469	12
49	74549	91951	82599	17401	08049	25451	11
50	9.74568	9.91942	9.82626	10.17374	10.08058	10.25432	10
51	74587	91934	82653	17347	08066	25413	9
52	74606	91925	82681	17319	08075	25394	8
53	74625	91917	82708	17292	08083	25375	7
54	74644	91908	82735	17265	08092	25356	6
55	74662	91900	82762	17238	08100	25338	5
56	74681	91891	82790	17210	08109	25319	4
57	74700	91883	82817	17183	08117	25300	3
58	74719	91874	82844	17156	08126	25281	2
59	74737	91866	82871	17129	08134	25263	1
60	74756	91857	82899	17101	08143	25244	0
	Co-sine.	Sine.	Co-tang.	Tangent	Co-secant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.72421	9.92842	9.79579	10.20421	10.07158	10.27579	60
1	72441	92834	79607	20393	07166	27559	59
2	72461	92826	79635	20365	07174	27539	58
3	72482	92818	79663	20337	07182	27518	57
4	72502	92810	79691	20309	07190	27498	56
5	72522	92803	79719	20281	07197	27478	55
6	72542	92795	79747	20253	07205	27458	54
7	72562	92787	79776	20224	07213	27438	53
8	72582	92779	79804	20196	07221	27418	52
9	72602	92771	79832	20168	07229	27398	51
10	9.72622	9.92763	9.79860	10.20140	10.07237	10.27378	50
11	72643	92755	79888	20112	07245	27357	49
12	72663	92747	79916	20084	07253	27337	48
13	72683	92739	79944	20056	07261	27317	47
14	72703	92731	79972	20028	07269	27297	46
15	72723	92723	80000	20000	07277	27277	45
16	72743	92715	80028	19972	07285	27257	44
17	72763	92707	80056	19944	07293	27237	43
18	72783	92699	80084	19916	07301	27217	42
19	72803	92691	80112	19888	07309	27197	41
20	9.72823	9.92683	9.80140	10.19860	10.07317	10.27177	40
21	72843	92675	80168	19832	07325	27157	39
22	72863	92667	80195	19805	07333	27137	38
23	72883	92659	80223	19777	07341	27117	37
24	72902	92651	80251	19749	07349	27098	36
25	72922	92643	80279	19721	07357	27078	35
26	72942	92635	80307	19693	07365	27058	34
27	72962	92627	80335	19665	07373	27038	33
28	72982	92619	80363	19637	07381	27018	32
29	73002	92611	80391	19609	07389	26998	31
30	9.73022	9.92603	9.80419	10.19581	10.07397	10.26978	30
31	73041	92595	80447	19553	07405	26959	29
32	73061	92587	80474	19526	07413	26939	28
33	73081	92579	80502	19498	07421	26919	27
34	73101	92571	80530	19470	07429	26899	26
35	73121	92563	80558	19442	07437	26879	25
36	73140	92555	80586	19414	07445	26860	24
37	73160	92546	80614	19386	07454	26840	23
38	73180	92538	80642	19358	07462	26820	22
39	73200	92530	80669	19331	07470	26800	21
40	9.73219	9.92522	9.80697	10.19303	10.07478	10.26781	20
41	73239	92514	80725	19275	07486	26761	19
42	73259	92506	80753	19247	07494	26741	18
43	73278	92498	80781	19219	07502	26722	17
44	73298	92490	80808	19192	07510	26702	16
45	73318	92482	80836	19164	07518	26682	15
46	73337	92473	80864	19136	07527	26663	14
47	73357	92465	80892	19108	07535	26643	13
48	73377	92457	80919	19081	07543	26623	12
49	73396	92449	80947	19053	07551	26604	11
50	9.73416	9.92441	9.80975	10.19025	10.07559	10.26584	10
51	73435	92433	81003	18997	07567	26565	9
52	73455	92425	81030	18970	07575	26545	8
53	73474	92416	81058	18942	07584	26526	7
54	73494	92408	81086	18914	07592	26506	6
55	73513	92400	81113	18887	07600	26487	5
56	73533	92392	81141	18859	07608	26467	4
57	73552	92384	81169	18831	07616	26448	3
58	73572	92376	81196	18804	07624	26428	2
59	73591	92367	81224	18776	07633	26409	1
60	73611	92359	81252	18748	07641	26389	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	M.
0	9.73611	9.92359	9.81252	10.18748	10.07641	10.26389	60
1	73630	92351	81279	18721	07649	26370	59
2	73650	92343	81307	18693	07657	26350	58
3	73669	92334	81335	18665	07666	26331	57
4	73689	92326	81362	18638	07674	26311	56
5	73708	92318	81390	18610	07682	26292	55
6	73727	92310	81418	18582	07690	26273	54
7	73747	92302	81445	18555	07698	26253	53
8	73766	92293	81473	18527	07707	26234	52
9	73785	92285	81500	18500	07715	26215	51
10	9.73805	9.92277	9.81528	10.18472	10.07723	10.26195	50
11	73824	92269	81556	18444	07731	26176	49
12	73843	92260	81583	18417	07740	26157	48
13	73863	92252	81611	18389	07748	26137	47
14	73882	92244	81638	18362	07756	26118	46
15	73901	92235	81666	18334	07765	26099	45
16	73921	92227	81693	18307	07773	26079	44
17	73940	92219	81721	18279	07781	26060	43
18	73959	92211	81748	18252	07789	26041	42
19	73978	92202	81776	18224	07798	26022	41
20	9.73997	9.92194	9.81803	10.18197	10.07806	10.26003	40
21	74017	92186	81831	18169	07814	25983	39
22	74036	92177	81858	18142	07823	25964	38
23	74055	92169	81886	18114	07831	25945	37
24	74074	92161	81913	18087	07839	25926	36
25	74093	92152	81941	18059	07848	25907	35
26	74113	92144	81968	18032	07856	25887	34
27	74132	92136	81996	18004	07864	25868	33
28	74151	92127	82023	17977	07873	25849	32
29	74170	92119	82051	17949	07881	25830	31
30	9.74189	9.92111	9.82078	10.17922	10.07889	10.25811	30
31	74208	92102	82106	17894	07898	25792	29
32	74227	92094	82133	17867	07906	25773	28
33	74246	92086	82161	17839	07914	25754	27
34	74265	92077	82188	17812	07923	25735	26
35	74284	92069	82215	17785	07931	25716	25
36	74303	92060	82243	17757	07940	25697	24
37	74322	92052	82270	17730	07948	25678	23
38	74341	92044	82298	17702	07956	25659	22
39	74360	92035	82325	17675	07965	25640	21
40	9.74379	9.92027	9.82352	10.17648	10.07973	10.25621	20
41	74398	92018	82380	17620	07982	25602	19
42	74417	92010	82407	17593	07990	25583	18
43	74436	92002	82435	17565	07998	25564	17
44	74455	91993	82462	17538	08007	25545	16
45	74474	91985	82489	17511	08015	25526	15
46	74493	91976	82517	17483	08024	25507	14
47	74512	91968	82544	17456	08032	25488	13
48	74531	91959	82571	17429	08041	25469	12
49	74549	91951	82599	17401	08049	25451	11
50	9.74568	9.91942	9.82626	10.17374	10.08058	10.25432	10
51	74587	91934	82653	17347	08066	25413	9
52	74606	91925	82681	17319	08075	25394	8
53	74625	91917	82708	17292	08083	25375	7
54	74644	91908	82735	17265	08092	25356	6
55	74662	91900	82762	17238	08100	25338	5
56	74681	91891	82790	17210	08109	25319	4
57	74700	91883	82817	17183	08117	25300	3
58	74719	91874	82844	17156	08126	25281	2
59	74737	91866	82871	17129	08134	25263	1
60	74756	91857	82899	17101	08143	25244	0
	Co-sine.	Sine.	Co-tang.	Tangent	Co-secant.	Secant.	M.

M.	Sine.	Co-fine.	Tangent.	Co-tang.	Secant.	Co-fecant.	
0	9.74756	9.91857	9.82899	10.17101	10.08143	10.25244	60
1	74775	91849	82926	17074	08151	25225	59
2	74794	91840	82953	17047	08160	25206	58
3	74812	91832	82980	17020	08168	25188	57
4	74831	91823	83008	16992	08177	25169	56
5	74850	91815	83035	16965	08185	25150	55
6	74868	91806	83062	16938	08194	25132	54
7	74887	91798	83089	16911	08202	25113	53
8	74906	91789	83117	16883	08211	25094	52
9	74924	91781	83144	16856	08219	25076	51
10	9.74943	9.91772	9.83171	10.16829	10.08228	10.25057	50
11	74961	91763	83198	16802	08237	25039	49
12	74980	91755	83225	16775	08245	25020	48
13	74999	91746	83252	16748	08254	25001	47
14	75017	91738	83280	16720	08262	24983	46
15	75036	91729	83307	16693	08271	24964	45
16	75054	91720	83334	16666	08280	24946	44
17	75073	91712	83361	16639	08288	24927	43
18	75091	91703	83388	16612	08297	24909	42
19	75110	91695	83415	16585	08305	24890	41
20	9.75128	9.91686	9.83442	10.16558	10.08314	10.24872	40
21	75147	91677	83470	16530	08323	24853	39
22	75165	91669	83497	16503	08331	24835	38
23	75184	91660	83524	16476	08340	24816	37
24	75202	91651	83551	16449	08349	24798	36
25	75221	91643	83578	16422	08357	24779	35
26	75239	91634	83605	16395	08366	24761	34
27	75258	91625	83632	16368	08375	24742	33
28	75276	91617	83659	16341	08383	24724	32
29	75294	91608	83686	16314	08392	24706	31
30	9.75313	9.91599	9.83713	10.16287	10.08401	10.24687	30
31	75331	91591	83740	16260	08409	24669	29
32	75350	91582	83768	16232	08418	24650	28
33	75368	91573	83795	16205	08427	24632	27
34	75386	91565	83822	16178	08435	24614	26
35	75405	91556	83849	16151	08444	24595	25
36	75423	91547	83876	16124	08453	24577	24
37	75441	91538	83903	16097	08462	24559	23
38	75459	91530	83930	16070	08470	24541	22
39	75478	91521	83957	16043	08479	24522	21
40	9.75496	9.91512	9.83984	10.16016	10.08488	10.24504	20
41	75514	91504	84011	15989	08496	24486	19
42	75533	91495	84038	15962	08505	24467	18
43	75551	91486	84065	15935	08514	24449	17
44	75569	91477	84092	15908	08523	24431	16
45	75587	91469	84119	15881	08531	24413	15
46	75605	91460	84146	15854	08540	24395	14
47	75624	91451	84173	15827	08549	24376	13
48	75642	91442	84200	15800	08558	24358	12
49	75660	91433	84227	15773	08567	24340	11
50	9.75678	9.91425	9.84254	10.15746	10.08575	10.24322	10
51	75696	91416	84280	15720	08584	24304	9
52	75714	91407	84307	15693	08593	24286	8
53	75733	91398	84334	15666	08602	24267	7
54	75751	91389	84361	15639	08611	24249	6
55	75769	91381	84388	15612	08619	24231	5
56	75787	91372	84415	15585	08628	24213	4
57	75805	91363	84442	15558	08637	24195	3
58	75823	91354	84469	15531	08646	24177	2
59	75841	91345	84496	15504	08655	24159	1
60	75859	91336	84523	15477	08664	24141	0
	Co-fine.	Sine.	Co-tang.	Tangent.	Co-fecant.	Secant.	M.

M.	Sine.	Co-fine.	Tangent.	Co-tang.	Secant.	Co-fecant.	
0	9.75859	9.91336	9.84523	10.15477	10.08664	10.24141	60
1	75877	91328	84550	15450	08672	24123	59
2	75895	91319	84576	15424	08681	24105	58
3	75913	91310	84603	15397	08690	24087	57
4	75931	91301	84630	15370	08699	24069	56
5	75949	91292	84657	15343	08708	24051	55
6	75967	91283	84684	15316	08717	24033	54
7	75985	91274	84711	15289	08726	24015	53
8	76003	91266	84738	15262	08734	23997	52
9	76021	91257	84764	15236	08743	23979	51
10	9.76039	9.91248	9.84791	10.15209	10.08752	10.23961	50
11	76057	91239	84818	15182	08761	23943	49
12	76075	91230	84845	15155	08770	23925	48
13	76093	91221	84872	15128	08779	23907	47
14	76111	91212	84899	15101	08788	23889	46
15	76129	91203	84925	15075	08797	23871	45
16	76146	91194	84952	15048	08806	23854	44
17	76164	91185	84979	15021	08815	23836	43
18	76182	91176	85006	14994	08824	23818	42
19	76200	91167	85033	14967	08833	23800	41
20	9.76218	9.91158	9.85059	10.14941	10.08842	10.23782	40
21	76236	91149	85086	14914	08851	23764	39
22	76253	91141	85113	14887	08859	23747	38
23	76271	91132	85140	14860	08868	23729	37
24	76289	91123	85166	14834	08877	23711	36
25	76307	91114	85193	14807	08886	23693	35
26	76324	91105	85220	14780	08895	23676	34
27	76342	91096	85247	14753	08904	23658	33
28	76360	91087	85273	14727	08913	23640	32
29	76378	91078	85300	14700	08922	23622	31
30	9.76395	9.91069	9.85327	10.14673	10.08931	10.23605	30
31	76413	91060	85354	14646	08940	23587	29
32	76431	91051	85380	14620	08949	23569	28
33	76448	91042	85407	14593	08958	23552	27
34	76466	91033	85434	14566	08967	23534	26
35	76484	91023	85460	14540	08977	23516	25
36	76501	91014	85487	14513	08986	23499	24
37	76519	91005	85514	14486	08995	23481	23
38	76537	90996	85540	14460	09004	23463	22
39	76554	90987	85567	14433	09013	23446	21
40	9.76572	9.90978	9.85594	10.14406	10.09022	10.23428	20
41	76590	90969	85620	14380	09031	23410	19
42	76607	90960	85647	14353	09040	23393	18
43	76625	90951	85674	14326	09049	23375	17
44	76642	90942	85700	14300	09058	23358	16
45	76660	90933	85727	14273	09067	23340	15
46	76677	90924	85754	14246	09076	23323	14
47	76695	90915	85780	14220	09085	23305	13
48	76712	90906	85807	14193	09094	23288	12
49	76730	90896	85834	14166	09104	23270	11
50	9.76747	9.90887	9.85860	10.14140	10.09113	10.23253	10
51	76765	90878	85887	14113	09122	23235	9
52	76782	90869	85913	14087	09131	23218	8
53	76800	90860	85940	14060	09140	23200	7
54	76817	90851	85967	14033	09149	23183	6
55	76835	90842	85993	14007	09158	23165	5
56	76852	90832	86020	13980	09168	23148	4
57	76870	90823	86046	13954	09177	23130	3
58	76887	90814	86073	13927	09186	23113	2
59	76904	90805	86100	13900	09195	23096	1
60	76922	90796	86126	13874	09204	23078	0
	Co-fine.	Sine.	Co-tang.	Tangent.	Co fecant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.76922	9.90796	9.86126	10.13874	10.09204	10.23078	60
1	76939	90787	86153	13847	09213	23061	59
2	76957	90777	86179	13821	09223	23043	58
3	76974	90768	86206	13794	09232	23026	57
4	76991	90759	86232	13768	09241	23009	56
5	77009	90750	86259	13741	09250	22991	55
6	77026	90741	86285	13715	09259	22974	54
7	77043	90731	86312	13688	09269	22957	53
8	77061	90722	86338	13662	09278	22939	52
9	77078	90713	86365	13635	09287	22922	51
10	9.77095	9.90704	9.86392	10.13608	10.09296	10.22905	50
11	77112	90694	86418	13582	09306	22888	49
12	77130	90685	86445	13555	09315	22870	48
13	77147	90676	86471	13529	09324	22853	47
14	77164	90667	86498	13502	09333	22836	46
15	77181	90657	86524	13476	09343	22819	45
16	77199	90648	86551	13449	09352	22801	44
17	77216	90639	86577	13423	09361	22784	43
18	77233	90630	86603	13397	09370	22767	42
19	77250	90620	86630	13370	09380	22750	41
20	9.77268	9.90611	9.86656	10.13344	10.09389	10.22732	40
21	77285	90602	86683	13317	09398	22715	39
22	77302	90592	86709	13291	09408	22698	38
23	77319	90583	86736	13264	09417	22681	37
24	77336	90574	86762	13238	09426	22664	36
25	77353	90565	86789	13211	09735	22647	35
26	77370	90555	86815	13185	09445	22630	34
27	77387	90546	86842	13158	09454	22613	33
28	77405	90537	86868	13132	09463	22595	32
29	77422	90527	86894	13106	09473	22578	31
30	9.77439	9.90518	9.86921	10.13079	10.09482	10.22561	30
31	77456	90509	86947	13053	09491	22544	29
32	77473	90499	86974	13026	09501	22527	28
33	77490	90490	87000	13000	09510	22510	27
34	77507	90480	87027	12973	09520	22493	26
35	77524	90471	87053	12947	09529	22476	25
36	77541	90462	87079	12921	09538	22459	24
37	77558	90452	87106	12894	09548	22442	23
38	77575	90443	87132	12868	09557	22425	22
39	77592	90434	87158	12842	09566	22408	21
40	9.77609	9.90424	9.87185	10.12815	10.09576	10.22391	20
41	77626	90415	87211	12789	09585	22374	19
42	77643	90405	87238	12762	09595	22357	18
43	77660	90396	87264	12736	09604	22340	17
44	77677	90386	87290	12710	09614	22323	16
45	77694	90377	87317	12683	09623	22306	15
46	77711	90368	87343	12657	09632	22289	14
47	77727	90358	87369	12631	09642	22273	13
48	77744	90349	87396	12604	09651	22256	12
49	77761	90339	87422	12578	09661	22239	11
50	9.77778	9.90330	9.87448	10.12552	10.09670	10.22222	10
51	77795	90320	87475	12525	09680	22205	9
52	77812	90311	87501	12499	09689	22188	8
53	77829	90301	87527	12473	09699	22171	7
54	77846	90292	87554	12446	09708	22154	6
55	77862	90282	87580	12420	09718	22138	5
56	77879	90273	87606	12394	09727	22121	4
57	77896	90263	87633	12367	09737	22104	3
58	77913	90254	87659	12341	09746	22087	2
59	77930	90244	87685	12315	09756	22070	1
60	77946	90235	87711	12289	09765	22054	0
	Co-sine.	Sine.	Co-tang.	Tangent	Co-secant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant	
0	9.79887	9.89050	9.90837	10.09163	10.10950	10.20113	60
1	79903	89040	90863	09137	10960	20097	59
2	79918	89030	90889	09111	10970	20082	58
3	79934	89020	90914	09086	10980	20066	57
4	79950	89009	90940	09060	10991	20050	56
5	79965	88999	90966	09034	11001	20035	55
6	79981	88989	90992	09008	11011	20019	54
7	79996	88978	91018	08982	11022	20004	53
8	80012	88968	91043	08957	11032	19988	52
9	80027	88958	91069	08931	11042	19973	51
10	9.80043	9.88948	9.91095	10.08905	10.11052	10.19957	50
11	80058	88937	91121	08879	11063	19942	49
12	80074	88927	91147	08853	11073	19926	48
13	80089	88917	91172	08828	11083	19911	47
14	80105	88906	91198	08802	11094	19895	46
15	80120	88896	91224	08776	11104	19880	45
16	80136	88886	91250	08750	11114	19864	44
17	80151	88875	91276	08724	11125	19849	43
18	80166	88865	91301	08699	11135	19834	42
19	80182	88855	91327	08673	11145	19818	41
20	9.80197	9.88844	9.91353	10.08647	10.11156	10.19803	40
21	80213	88834	91379	08621	11166	19787	39
22	80228	88824	91404	08596	11176	19772	38
23	80244	88813	91430	08570	11187	19756	37
24	80259	88803	91456	08544	11197	19741	36
25	80274	88793	91482	08518	11207	19726	35
26	80290	88782	91507	08493	11218	19710	34
27	80305	88772	91533	08467	11228	19695	33
28	80320	88761	91559	08441	11239	19680	32
29	80336	88751	91585	08415	11249	19664	31
30	9.80351	9.88741	9.91610	10.08390	10.11259	10.19649	30
31	80366	88730	91636	08364	11270	19634	29
32	80382	88720	91662	08338	11280	19618	28
33	80397	88709	91688	08312	11291	19603	27
34	80412	88699	91713	08287	11301	19588	26
35	80428	88688	91739	08261	11312	19572	25
36	80443	88678	91765	08235	11322	19557	24
37	80458	88668	91791	08209	11332	19542	23
38	80473	88657	91816	08184	11343	19527	22
39	80489	88647	91842	08158	11353	19511	21
40	9.80504	9.88636	9.91868	10.08132	10.11364	10.19496	20
41	80519	88626	91893	08107	11374	19481	19
42	80534	88615	91919	08081	11385	19466	18
43	80550	88605	91945	08055	11395	19450	17
44	80565	88594	91971	08029	11406	19435	16
45	80580	88584	91996	08004	11416	19420	15
46	80595	88573	92022	07978	11427	19405	14
47	80610	88563	92048	07952	11437	19390	13
48	80625	88552	92073	07927	11448	19375	12
49	80641	88542	92099	07901	11458	19359	11
50	9.80656	9.88531	9.92125	10.07875	10.11469	10.19344	10
51	80671	88521	92150	07850	11479	19329	9
52	80686	88510	92176	07824	11490	19314	8
53	80701	88499	92202	07798	11501	19299	7
54	80716	88489	92227	07773	11511	19284	6
55	80731	88478	92253	07747	11522	19269	5
56	80746	88468	92279	07721	11532	19254	4
57	80762	88457	92304	07696	11543	19238	3
58	80777	88447	92330	07670	11553	19223	2
59	80792	88436	92356	07644	11564	19208	1
60	80807	88425	92381	07619	11575	19193	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co fine.	Tangent.	Co-tang	Secant.	Co-fecant.	
0	9.80807	9.88425	9.92381	10.07619	10.11575	10.19193	60
1	80822	88415	92407	07593	11585	19178	59
2	80837	88404	92433	07567	11596	19163	58
3	80852	88394	92458	07542	11606	19148	57
4	80867	88383	92484	07516	11617	19133	56
5	80882	88372	92510	07490	11628	19118	55
6	80897	88362	92535	07465	11638	19103	54
7	80912	88351	92561	07439	11649	19088	53
8	80927	88340	92587	07413	11660	19073	52
9	80942	88330	92612	07388	11670	19058	51
10	9.80957	9.88319	9.92638	10.07362	10.11681	10.19043	50
11	80972	88308	92663	07337	11692	19028	49
12	80987	88298	92689	07311	11702	19013	48
13	81002	88287	92715	07285	11713	18998	47
14	81017	88276	92740	07260	11724	18983	46
15	81032	88266	92766	07234	11734	18968	45
16	81047	88255	92792	07208	11745	18954	44
17	81061	88244	92817	07183	11756	18939	43
18	81076	88234	92843	07157	11766	18924	42
19	81091	88223	92868	07132	11777	18909	41
20	9.81106	9.88212	9.92894	10.07106	10.11788	10.18894	40
21	81121	88201	92920	07080	11799	18879	39
22	81136	88191	92945	07055	11809	18864	38
23	81151	88180	92971	07029	11820	18849	37
24	81166	88169	92996	07004	11831	18834	36
25	81180	88158	93022	06978	11842	18820	35
26	81195	88148	93048	06952	11852	18805	34
27	81210	88137	93073	06927	11863	18790	33
28	81225	88126	93099	06901	11874	18775	32
29	81240	88115	93124	06876	11885	18760	31
30	9.81254	9.88105	9.93150	10.06850	10.11895	10.18746	30
31	81269	88094	93175	06825	11906	18731	29
32	81284	88083	93201	06799	11917	18716	28
33	81299	88072	93227	06773	11928	18701	27
34	81314	88061	93252	06748	11939	18686	26
35	81328	88051	93278	06722	11949	18672	25
36	81343	88040	93303	06697	11960	18657	24
37	81358	88029	93329	06671	11971	18642	23
38	81372	88018	93354	06646	11982	18628	22
39	81387	88007	93380	06620	11993	18613	21
40	9.81402	9.87996	9.93406	10.06594	10.12004	10.18598	20
41	81417	87985	93431	06569	12015	18583	19
42	81431	87975	93457	06543	12025	18569	18
43	81446	87964	93482	06518	12036	18554	17
44	81461	87953	93508	06492	12047	18539	16
45	81475	87942	93533	06467	12058	18525	15
46	81490	87931	93559	06441	12069	18510	14
47	81505	87920	93584	06416	12080	18495	13
48	81519	87909	93610	06390	12091	18481	12
49	81534	87898	93636	06364	12102	18466	11
50	9.81549	9.87887	9.93661	10.06339	10.12113	10.18451	10
51	81563	87877	93687	06313	12123	18437	9
52	81578	87866	93712	06288	12134	18422	8
53	81592	87855	93738	06262	12145	18408	7
54	81607	87844	93763	06237	12156	18393	6
55	81622	87833	93789	06211	12167	18378	5
56	81636	87822	93814	06186	12178	18364	4
57	81651	87811	93840	06160	12189	18349	3
58	81665	87800	93865	06135	12200	18335	2
59	81680	87789	93891	06109	12211	18320	1
60	81694	87778	93916	06084	12222	18306	0
	Co fine.	Sine.	Co-tang.	Tangent.	Co-fecant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant	Co-secant	
0	9.81694	9.87778	9.93916	10.06084	10.12222	10.18306	60
1	81709	87767	93942	06058	12233	18291	59
2	81723	87756	93967	06033	12244	18277	58
3	81738	87745	93993	06007	12255	18262	57
4	81752	87734	94018	05982	12266	18248	56
5	81767	87723	94044	05956	12277	18233	55
6	81781	87712	94069	05931	12288	18219	54
7	81796	87701	94095	05905	12299	18204	53
8	81810	87690	94120	05880	12310	18190	52
9	81825	87679	94146	05854	12321	18175	51
10	9.81839	9.87668	9.94171	10.05829	10.12332	10.18161	50
11	81854	87657	94197	05803	12343	18146	49
12	81868	87646	94222	05778	12354	18132	48
13	81882	87635	94248	05752	12365	18118	47
14	81897	87624	94273	05727	12376	18103	46
15	81911	87613	94299	05701	12387	18089	45
16	81926	87601	94324	05676	12399	18074	44
17	81940	87590	94350	05650	12410	18060	43
18	81955	87579	94375	05625	12421	18045	42
19	81969	87568	94401	05599	12432	18031	41
20	9.81983	9.87557	9.94426	10.05574	10.12443	10.18017	40
21	81998	87546	94452	05548	12454	18002	39
22	82012	87535	94477	05523	12465	17988	38
23	82026	87524	94503	05497	12476	17974	37
24	82041	87513	94528	05472	12487	17959	36
25	82055	87501	94554	05446	12499	17945	35
26	82069	87490	94579	05421	12510	17931	34
27	82084	87479	94604	05396	12521	17916	33
28	82098	87468	94630	05370	12532	17902	32
29	82112	87457	94655	05345	12543	17888	31
30	9.82126	9.87446	9.94681	10.05319	10.12554	10.17874	30
31	82141	87434	94706	05294	12566	17859	29
32	82155	87423	94732	05268	12577	17845	28
33	82169	87412	94757	05243	12588	17831	27
34	82184	87401	94783	05217	12599	17816	26
35	82198	87390	94808	05192	12610	17802	25
36	82212	87378	94834	05166	12622	17788	24
37	82226	87367	94859	05141	12633	17774	23
38	82240	87356	94884	05116	12644	17760	22
39	82255	87345	94910	05090	12655	17745	21
40	9.82269	9.87334	9.94935	10.05065	10.12666	10.17731	20
41	82283	87322	94961	05039	12678	17717	19
42	82297	87311	94986	05014	12689	17703	18
43	82311	87300	95012	04988	12700	17689	17
44	82326	87288	95037	04963	12712	17674	16
45	82340	87277	95062	04938	12723	17660	15
46	82354	87266	95088	04912	12734	17646	14
47	82368	87255	95113	04887	12745	17632	13
48	82382	87243	95139	04861	12757	17618	12
49	82396	87232	95164	04836	12768	17604	11
50	9.82410	9.87221	9.95190	10.04810	10.12779	10.17590	10
51	82424	87209	95215	04785	12791	17576	9
52	82439	87198	95240	04760	12802	17561	8
53	82453	87187	95266	04734	12813	17547	7
54	82467	87175	95291	04709	12825	17533	6
55	82481	87164	95317	04683	12836	17519	5
56	82495	87153	95342	04658	12847	17505	4
57	82509	87141	95368	04632	12859	17491	3
58	82523	87130	95393	04607	12870	17477	2
59	82537	87119	95418	04582	12881	17463	1
60	82551	87107	95444	04556	12893	17449	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Sine.	Co-fine.	Tangent.	Co-tang.	Secant.	Co-fecant.	
0	9.82551	9.87107	9.95444	10.04556	10.12893	10.17449	60
1	82565	87096	95469	04531	12904	17435	59
2	82579	87085	95495	04505	12915	17421	58
3	82593	87073	95520	04480	12927	17407	57
4	82607	87062	95545	04455	12938	17393	56
5	82621	87050	95571	04429	12950	17379	55
6	82635	87039	95596	04404	12961	17365	54
7	82649	87028	95622	04378	12972	17351	53
8	82663	87016	95647	04353	12984	17337	52
9	82677	87005	95672	04328	12995	17323	51
10	9.82691	9.86993	9.95698	10.04302	10.13007	10.17309	50
11	82705	86982	95723	04277	13018	17295	49
12	82719	86970	95748	04252	13030	17281	48
13	82733	86959	95774	04226	13041	17267	47
14	82747	86947	95799	04201	13053	17253	46
15	82761	86936	95825	04175	13064	17239	45
16	82775	86924	95850	04150	13076	17225	44
17	82788	86913	95875	04125	13087	17212	43
18	82802	86902	95901	04099	13098	17198	42
19	82816	86890	95926	04074	13110	17184	41
20	9.82830	9.86879	9.95952	10.04048	10.13121	10.17170	40
21	82844	86867	95977	04023	13133	17156	39
22	82858	86855	96002	03998	13145	17142	38
23	82872	86844	96028	03972	13156	17128	37
24	82885	86832	96053	03947	13168	17115	36
25	82899	86821	96078	03922	13179	17101	35
26	82913	86809	96104	03896	13191	17087	34
27	82927	86798	96129	03871	13202	17073	33
28	82941	86786	96155	03845	13214	17059	32
29	82955	86775	96180	03820	13225	17045	31
30	9.82968	9.86763	9.96205	10.03795	10.13237	10.17032	30
31	82982	86752	96231	03769	13248	17018	29
32	82996	86740	96256	03744	13260	17004	28
33	83010	86728	96281	03719	13272	16990	27
34	83023	86717	96307	03693	13283	16977	26
35	83037	86705	96332	03668	13295	16963	25
36	83051	86694	96357	03643	13306	16949	24
37	83065	86682	96383	03617	13318	16935	23
38	83078	86670	96408	03592	13330	16922	22
39	83092	86659	96433	03567	13341	16908	21
40	9.83106	9.86647	9.96459	10.03541	10.13353	10.16894	20
41	83120	86635	96484	03516	13365	16880	19
42	83133	86624	96510	03490	13376	16867	18
43	83147	86612	96535	03465	13388	16853	17
44	83161	86600	96560	03440	13400	16839	16
45	83174	86589	96586	03414	13411	16826	15
46	83188	86577	96611	03389	13423	16812	14
47	83202	86565	96636	03364	13435	16798	13
48	83215	86554	96662	03338	13446	16785	12
49	83229	86542	96687	03313	13458	16771	11
50	9.83242	9.86530	9.96712	10.03288	10.13470	10.16758	10
51	83256	86518	96738	03262	13482	16744	9
52	83270	86507	96763	03237	13493	16730	8
53	83283	86495	96788	03212	13505	16717	7
54	83297	86483	96814	03186	13517	16703	6
55	83311	86472	96839	03161	13528	16699	5
56	83324	86460	96864	03136	13540	16676	4
57	83338	86448	96890	03110	13552	16662	3
58	83351	86436	96915	03085	13564	16649	2
59	83365	86425	96940	03060	13575	16635	1
60	83378	86413	96966	03034	13587	16622	0
	Co-fine.	Sine.	Co-tang.	Tangent.	Co-fecant	Secant.	M.

M.	Sine.	Co-fine.	Tangent.	Co-tang.	Secant.	Co-fecant.	
0	9.83378	9.86413	9.96966	10.03034	10.13587	10.16622	60
1	83392	86401	96991	03009	13599	16608	59
2	83405	86329	97016	02984	13611	16595	58
3	83419	86377	97042	02958	13623	16581	57
4	83432	86366	97067	02933	13634	16568	56
5	83446	86354	97092	02908	13646	16554	55
6	83459	86342	97118	02882	13658	16541	54
7	83473	86330	97143	02857	13670	16527	53
8	83480	86318	97168	02832	13682	16514	52
9	83500	86306	97193	02807	13694	16500	51
10	9.83513	9.86295	9.97219	10.02781	10.13705	10.16487	50
11	83527	86283	97244	02756	13717	16473	49
12	83540	86271	97269	02731	13729	16460	48
13	83554	86259	97295	02705	13741	16446	47
14	83567	86247	97320	02680	13753	16433	46
15	83581	86235	97345	02655	13765	16419	45
16	83594	86223	97371	02629	13777	16406	44
17	83608	86211	97396	02604	13789	16392	43
18	83621	86200	97421	02579	13800	16379	42
19	83634	86188	97447	02553	13812	16366	41
20	9.83648	9.86176	9.97472	10.02528	10.13824	10.16352	40
21	83661	86164	97497	02503	13836	16339	39
22	83674	86152	97523	02477	13848	16326	38
23	83688	86140	97548	02452	13860	16312	37
24	83701	86128	97573	02427	13872	16299	36
25	83715	86116	97598	02402	13884	16285	35
26	83728	86104	97624	02376	13896	16272	34
27	83741	86092	97649	02351	13908	16259	33
28	83755	86080	97674	02326	13920	16245	32
29	83768	86068	97700	02300	13932	16232	31
30	9.83781	9.86056	9.97725	10.02275	10.13944	10.16219	30
31	83795	86044	97750	02250	13956	16205	29
32	83808	86032	97776	02224	13968	16192	28
33	83821	86020	97801	02199	13980	16179	27
34	83834	86008	97826	02174	13992	16166	26
35	83848	85996	97851	02149	14004	16152	25
36	83861	85984	97877	02123	14016	16139	24
37	83874	85972	97902	02098	14028	16126	23
38	83887	85960	97927	02073	14040	16113	22
39	83901	85948	97953	02047	14052	16099	21
40	9.83914	9.85936	9.97978	10.02022	10.14064	10.16086	20
41	83927	85924	98003	01997	14076	16073	19
42	83940	85912	98029	01971	14088	16060	18
43	83954	85900	98054	01946	14100	16046	17
44	83967	85888	98079	01921	14112	16033	16
45	83980	85876	98104	01896	14124	16020	15
46	83993	85864	98130	01870	14136	16007	14
47	84006	85851	98155	01845	14149	15994	13
48	84020	85839	98180	01820	14161	15980	12
49	84033	85827	98206	01794	14173	15967	11
50	9.84046	9.85815	9.98231	10.01769	10.14185	10.15954	10
51	84059	85803	98256	01744	14197	15941	9
52	84072	85791	98281	01719	14209	15928	8
53	84085	85779	98307	01693	14221	15915	7
54	84099	85766	98332	01668	14234	15901	6
55	84112	85754	98357	01643	14246	15888	5
56	84125	85742	98383	01617	14258	15875	4
57	84138	85730	98408	01592	14270	15862	3
58	84151	85718	98433	01567	14282	15849	2
59	84164	85706	98458	01542	14294	15836	1
60	84177	85693	98484	01516	14307	15823	0
	Co-fine.	Sine.	Co-tang.	Tangent.	Co-fecant	Secant.	M.

M.	Sine.	Co-fine.	Tangent.	Co-tang.	Secant.	Co-fecant.	
0	9.84177	9.85693	9.98484	10.05616	10.14307	10.15823	60
1	84190	85681	98509	01491	14319	15810	59
2	84203	85669	98534	01466	14331	15797	58
3	84216	85657	98560	01440	14343	15784	57
4	84229	85645	98585	01415	14355	15771	56
5	84242	85632	98610	01390	14368	15758	55
6	84255	85620	98635	01365	14380	15745	54
7	84269	85608	98661	01339	14392	15731	53
8	84282	85596	98686	01314	14404	15718	52
9	84295	85583	98711	01289	14417	15705	51
10	9.84308	9.85571	9.98737	10.01263	10.14429	10.15692	50
11	84321	85559	98762	01238	14441	15679	49
12	84334	85547	98787	01213	14453	15666	48
13	84347	85534	98812	01188	14466	15653	47
14	84360	85522	98838	01162	14478	15640	46
15	84373	85510	98863	01137	14490	15627	45
16	84385	85497	98888	01112	14503	15615	44
17	84398	85785	98913	01087	14515	15602	43
18	84411	85473	98939	01061	14527	15589	42
19	84424	85460	98964	01036	14540	15576	41
20	9.84437	9.85448	9.98989	10.01011	10.14552	10.15563	40
21	84450	85436	99015	00985	14564	15550	39
22	84463	85423	99040	00960	14577	15537	38
23	84476	85411	99065	00935	14589	15524	37
24	84489	85399	99090	00910	14601	15511	36
25	84502	85386	99116	00884	14614	15498	35
26	84515	85374	99141	00859	14626	15485	34
27	84528	85361	99166	00834	14639	15472	33
28	84540	85349	99191	00809	14651	15460	32
29	84553	85337	99217	00783	14663	15447	31
30	9.84566	9.85324	9.99242	10.00758	10.14676	10.15434	30
31	84579	85312	99267	00733	14688	15421	29
32	84592	85299	99293	00707	14701	15408	28
33	84605	85287	99318	00682	14713	15395	27
34	84618	85274	99343	00657	14726	15382	26
35	84630	85262	99368	00632	14738	15370	25
36	84643	85250	99394	00606	14750	15357	24
37	84656	85237	99419	00581	14763	15344	23
38	84669	85225	99444	00556	14775	15331	22
39	84682	85212	99469	00531	14788	15318	21
40	9.84694	9.85200	9.99495	10.00505	10.14800	10.15306	20
41	84707	85187	99520	00480	14813	15293	19
42	84720	85175	99545	00455	14825	15280	18
43	84733	85162	99570	00430	14838	15267	17
44	84745	85150	99596	00404	14850	15255	16
45	84758	85137	99621	00379	14863	15242	15
46	84771	85125	99646	00354	14875	15229	14
47	84784	85112	99672	00328	14888	15216	13
48	84796	85100	99697	00303	14900	15204	12
49	84809	85087	99722	00278	14913	15191	11
50	9.84821	9.85074	9.99747	10.00253	10.14926	10.15178	10
51	84835	85062	99773	00227	14938	15165	9
52	84847	85049	99798	00202	14951	15153	8
53	84860	85037	99823	00177	14963	15140	7
54	84873	85024	99848	00152	14976	15127	6
55	84885	85012	99874	00126	14988	15115	5
56	84898	84999	99899	00101	15001	15102	4
57	84911	84986	99924	00076	15014	15089	3
58	84923	84974	99949	00051	15026	15077	2
59	84936	84961	99975	00025	15039	15064	1
60	84949	84949	10.0000	00000	15051	15051	0
	Co-fine.	Sine.	Co-tang.	Tangent.	Co-fecant.	Secant.	M.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.83378	9.86413	9.96966	10.03034	10.13587	10.16622	60
1	83392	86401	96991	03009	13599	16608	59
2	83405	86329	97016	02984	13611	16595	58
3	83419	86377	97042	02958	13623	16581	57
4	83432	86366	97067	02933	13634	16568	56
5	83446	86354	97092	02908	13646	16554	55
6	83459	86342	97118	02882	13658	16541	54
7	83473	86330	97143	02857	13670	16527	53
8	83480	86318	97168	02832	13682	16514	52
9	83500	86306	97193	02807	13694	16500	51
10	9.83513	9.86295	9.97219	10.02781	10.13705	10.16487	50
11	83527	86283	97244	02756	13717	16473	49
12	83540	86271	97269	02731	13729	16460	48
13	83554	86259	97295	02705	13741	16446	47
14	83567	86247	97320	02680	13753	16433	46
15	83581	86235	97345	02655	13765	16419	45
16	83594	86223	97371	02629	13777	16406	44
17	83608	86211	97396	02604	13789	16392	43
18	83621	86200	97421	02579	13800	16379	42
19	83634	86188	97447	02553	13812	16366	41
20	9.83648	9.86176	9.97472	10.02528	10.13824	10.16352	40
21	83661	86164	97497	02503	13836	16339	39
22	83674	86152	97523	02477	13848	16326	38
23	83688	86140	97548	02452	13860	16312	37
24	83701	86128	97573	02427	13872	16299	36
25	83715	86116	97598	02402	13884	16285	35
26	83728	86104	97624	02376	13896	16272	34
27	83741	86092	97649	02351	13908	16259	33
28	83755	86080	97674	02326	13920	16245	32
29	83768	86068	97700	02300	13932	16232	31
30	9.83781	9.86056	9.97725	10.02275	10.13944	10.16219	30
31	83795	86044	97750	02250	13956	16205	29
32	83808	86032	97776	02224	13968	16192	28
33	83821	86020	97801	02199	13980	16179	27
34	83834	86008	97826	02174	13992	16166	26
35	83848	85996	97851	02149	14004	16152	25
36	83861	85984	97877	02123	14016	16139	24
37	83874	85972	97902	02098	14028	16126	23
38	83887	85960	97927	02073	14040	16113	22
39	83901	85948	97953	02047	14052	16099	21
40	9.83914	9.85936	9.97978	10.02022	10.14064	10.16086	20
41	83927	85924	98003	01997	14076	16073	19
42	83940	85912	98029	01971	14088	16060	18
43	83954	85900	98054	01946	14100	16046	17
44	83967	85888	98079	01921	14112	16033	16
45	83980	85876	98104	01896	14124	16020	15
46	83993	85864	98130	01870	14136	16007	14
47	84006	85851	98155	01845	14149	15994	13
48	84020	85839	98180	01820	14161	15980	12
49	84033	85827	98206	01794	14173	15967	11
50	9.84046	9.85815	9.98231	10.01769	10.14185	10.15954	10
51	84059	85803	98256	01744	14197	15941	9
52	84072	85791	98281	01719	14209	15928	8
53	84085	85779	98307	01693	14221	15915	7
54	84099	85766	98332	01668	14234	15901	6
55	84112	85754	98357	01643	14246	15888	5
56	84125	85742	98383	01617	14258	15875	4
57	84138	85730	98408	01592	14270	15862	3
58	84151	85718	98433	01567	14282	15849	2
59	84164	85706	98458	01542	14294	15836	1
60	84177	85693	98484	01516	14307	15823	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.

TABLE VI. : MERIDIONAL PARTS.

M	14d.	15d.	16d.	17d.	18d.	19d.	20d.	21d.	22d.	23d.	24d.	25d.	26d.	27d.	M.
0	849	910	973	1035	1098	1161	1225	1289	1354	1419	1484	1550	1617	1684	0
1	850	911	974	1036	1099	1162	1226	1290	1355	1420	1485	1551	1618	1685	1
2	851	913	975	1037	1100	1164	1227	1291	1356	1421	1486	1552	1619	1686	2
3	852	914	976	1038	1101	1165	1228	1292	1357	1422	1487	1553	1620	1687	3
4	853	915	977	1040	1102	1166	1229	1294	1358	1423	1488	1554	1621	1688	4
5	854	916	978	1041	1104	1167	1230	1295	1359	1424	1490	1556	1622	1689	5
6	855	917	979	1042	1105	1168	1232	1296	1360	1425	1491	1557	1623	1690	6
7	856	918	980	1043	1106	1169	1233	1297	1361	1426	1492	1558	1624	1691	7
8	857	919	981	1044	1107	1170	123	1298	1362	1427	1493	1559	1625	1693	8
9	858	920	982	1045	1108	1171	1235	1299	1363	1428	1494	1560	1627	1694	9
10	859	921	983	1046	1109	1172	1236	1300	1365	1430	1495	1561	1628	1695	10
11	860	922	984	1047	1110	1173	1237	1301	1366	1431	1496	1562	1629	1696	11
12	861	923	985	1048	1111	1174	1238	1302	1367	1432	1497	1563	163	1697	12
13	862	924	986	1049	1112	117	1239	1303	1368	1433	1498	1564	1632	1698	13
14	863	925	987	1050	1113	1176	1240	1304	1369	1434	1499	1566	1633	1699	14
15	864	926	988	1051	1114	1177	1241	1305	1370	1435	1501	1567	1635	1700	15
16	865	927	989	1052	1115	1178	1242	1306	1371	1436	1502	1568	1634	1702	16
17	866	928	990	1053	1116	1180	1243	1307	1372	1437	1503	1569	1636	1703	17
18	867	929	992	1054	1117	1181	1244	1309	1373	1438	1504	1570	1637	1704	18
19	868	930	993	1055	1118	1182	1245	1310	1374	1439	1505	1571	1638	1705	19
20	869	931	994	1056	1119	1183	1246	1311	1375	1440	1506	1572	1639	1706	20
21	870	932	995	1057	1120	1184	1248	1312	1376	1442	1507	1573	1640	1707	21
22	871	933	996	1058	1121	1185	1249	1313	1377	1443	1508	1574	1641	1708	22
23	872	934	997	1059	1122	1186	1250	1314	1379	1444	1509	1575	1642	1709	23
24	873	935	998	1060	1123	1187	1251	1315	1380	1445	1510	1577	1643	1711	24
25	874	936	999	1061	1125	1188	1252	1316	1381	1446	1512	1578	1644	1712	25
26	875	937	1000	1063	1126	1189	1253	1317	1382	1447	1513	1579	1646	1713	26
27	876	938	1001	1064	1127	1190	1254	1318	1383	1448	1514	1580	1647	1714	27
28	878	939	1002	1065	1128	1191	1255	1319	1384	1449	1515	1581	1648	1715	28
29	879	941	1003	1066	1129	1192	1256	1320	1385	1450	1516	1582	1649	1716	29
30	880	942	1004	1067	1130	1193	1257	1321	1386	1451	1517	1583	1650	1717	30
31	881	943	1005	1068	1131	1194	1258	1323	387	1452	1518	1584	1651	1719	31
32	882	944	1006	1069	1132	1195	1259	1324	1388	1454	1519	1585	1652	1720	32
33	883	945	1007	1070	1133	1196	1260	1325	1389	1455	1520	1587	1653	1721	33
34	884	946	1008	1071	1134	1198	1261	1326	1390	1456	1521	1588	1654	1722	34
35	885	947	1009	1072	1135	1199	1262	1327	1392	1457	152	1589	1656	1723	35
36	886	948	1010	1073	1136	1200	1264	1328	1393	1458	1524	1590	1657	1724	36
37	887	949	1011	1074	1137	1201	1265	1329	1394	1459	1525	1591	1658	1725	37
38	888	950	1012	1075	1138	1202	1266	1330	1395	1460	1526	1592	1659	1726	38
39	889	951	1013	1076	1139	1203	1267	1331	1396	1461	1527	1593	1660	1727	39
40	890	952	1014	1077	1140	1204	1268	1332	1397	1462	1528	1594	1661	1729	40
41	891	953	1015	1078	1141	1205	1269	1333	1398	1463	1529	1595	1662	1730	41
42	892	954	1017	1079	1142	1206	1270	1334	1399	1465	1530	1597	1663	1731	42
43	893	955	1018	1080	1144	1207	1271	1335	1400	1466	1531	1598	1665	1732	43
44	894	956	1019	1081	1145	1208	1272	1336	1401	1467	1532	1599	1666	1733	44
45	895	957	1020	1083	1146	1209	1273	1338	1402	1468	1534	1600	1667	1734	45
46	896	958	1021	1084	1147	1210	1274	1339	1403	1469	1535	1601	1668	1735	46
47	897	959	1022	1085	1148	1211	1275	1340	1405	1470	1536	1602	1669	1737	47
48	898	960	1023	1086	1149	1212	1276	1341	1406	1471	1537	1603	1670	1738	48
49	899	961	1024	1087	1150	1213	1277	1342	1407	1472	1538	1604	1671	1739	49
50	900	962	1025	1088	1151	1215	1279	1343	1408	1473	1539	1605	1672	1740	50
51	901	963	1026	1089	1152	1216	1280	1344	1409	1474	1540	1607	1673	1741	51
52	902	964	1027	1090	1153	1217	1281	1345	1410	1475	1541	1608	1675	1742	52
53	903	966	1028	1091	1154	1218	1282	1346	1411	1476	1542	1609	1676	1743	53
54	904	967	1029	1092	1155	1219	1283	1347	1412	1478	1543	1610	1677	1744	54
55	905	968	1030	1093	1156	1220	1284	1348	1413	1479	1545	1611	1678	1746	55
56	906	969	1031	1094	1157	1221	1285	1349	1414	1480	1546	1612	1679	1747	56
57	907	970	1032	1095	1158	1222	1286	1350	1415	1481	1547	1613	1680	1748	57
58	908	971	1033	1096	1159	1223	1287	1352	1417	1482	1548	1614	1681	1749	58
59	909	972	1034	1097	1160	1224	1288	1353	1418	1483	1549	1615	1682	1750	59
M.	14d	15d	16d.	17d.	18d	19d.	20d.	21d.	22d	23d.	24d.	25d.	26d.	27d.	M.

Table VI. Meridional Parts.

M.	28d.	29d.	30d.	31d.	32d.	33d.	34d.	35d.	36d.	37d.	38d.	39d.	40d.	41d.	M.
0	1751	1820	1888	1958	2028	2100	2172	2244	2318	2393	2468	2545	2623	2702	0
1	1752	1821	1890	1959	2030	2101	2173	2246	2319	2394	2470	2546	2624	2703	1
2	1753	1822	1891	1960	2031	2102	2174	2247	2321	2395	2471	2548	2625	2704	2
3	1755	1823	1892	1962	2032	2103	2175	2248	2322	2396	2472	2549	2627	2706	3
4	1756	1824	1893	1963	2033	2104	2176	2249	2323	2398	2473	2550	2628	2707	4
5	1757	1825	1894	1964	2034	2106	2178	2250	2324	2399	2475	2551	2629	2708	5
6	1758	1826	1895	1965	2036	2107	2179	2252	2325	2400	2476	2553	2631	2710	6
7	1759	1828	1897	1966	2037	2108	2180	2253	2327	2401	2477	2554	2632	2711	7
8	1760	1829	1898	1967	2038	2109	2181	2254	2328	2403	2479	2555	2633	2712	8
9	1761	1830	1899	1969	2039	2110	2182	2255	2329	2404	2480	2557	2635	2714	9
10	1763	1831	1900	1970	2040	2112	2184	2257	2330	2405	2481	2558	2636	2715	10
11	1764	1832	1901	1971	2041	2113	2185	2258	2332	2406	2482	2559	2637	2716	11
12	1765	1833	1902	1972	2043	2114	2186	2259	2333	2408	2484	2560	2638	2718	12
13	1766	1834	1903	1973	2044	2115	2187	2260	2334	2409	2485	2562	2640	2719	13
14	1767	1836	1905	1974	2045	2116	2188	2261	2335	2410	2486	2563	2641	2720	14
15	1768	1837	1906	1976	2046	2118	2190	2263	2337	2412	2487	2564	2642	2722	15
16	1769	1838	1907	1977	2047	2119	2191	2264	2338	2413	2489	2566	2644	2723	16
17	1771	1839	1908	1978	2049	2120	2192	2265	2339	2414	2490	2567	2645	2724	17
18	1772	1840	1909	1 79	2050	2121	2193	2266	2340	2415	2491	2568	2646	2726	18
19	1773	1841	1910	1980	2051	2122	2195	2268	2342	2417	2493	2570	2648	2727	19
20	1774	1842	1912	1981	2052	2123	2196	2269	2343	2418	2494	2571	2649	2728	20
21	1775	1844	1913	1982	2053	2125	2197	2270	2344	2419	2495	2572	2650	2730	21
22	1776	1845	1914	1984	2054	2126	2198	2271	2345	2420	2496	2573	2652	2731	22
23	1777	1846	1915	1985	2056	2127	2199	2273	2347	2422	2498	2575	2653	2732	23
24	1778	1847	1916	1986	2057	2128	2201	2274	2348	2423	2499	2576	2654	2734	24
25	1780	1848	1917	1987	2058	2129	2202	2275	2349	2424	2500	2577	2656	2735	25
26	1781	1849	1919	1988	2059	2131	2203	2276	2350	2425	2501	2579	2657	2736	26
27	1782	1850	1920	1990	2060	2132	2204	2277	2352	2427	2503	2580	2658	2737	27
28	1783	1852	1921	1991	2062	2133	2205	2279	2353	2428	2504	2581	2659	2739	28
29	1784	1853	1922	1992	2063	2134	2207	2280	2354	2429	2505	2582	2661	2740	29
30	1785	1854	1923	1993	2064	2135	2208	2281	2355	2430	2507	2584	2662	2742	30
31	1786	1855	1924	1994	2065	2137	2209	2282	2357	2432	2508	2585	2663	2743	31
32	1788	1856	1925	1996	2066	2138	2210	2284	2358	2433	2509	2586	2665	2744	32
33	1789	1857	1927	1997	2067	2139	2211	2285	2359	2434	2510	2588	2666	2746	33
34	1790	1858	2928	1998	2069	2140	2213	2286	2360	2435	2512	2589	2667	2747	34
35	1791	1860	1929	1999	2070	2141	2214	2287	2361	2437	2513	2590	2669	2748	35
36	1792	1861	1930	2000	2071	2143	2215	2288	2363	2438	2514	2592	2670	2750	36
37	1793	1862	1931	2001	2072	2144	2216	2290	2364	2439	2515	2593	2671	2751	37
38	1794	1863	1932	2003	2073	2145	2218	2291	2365	2440	2517	2594	2673	2752	38
39	1796	1864	1934	2004	2075	2146	2219	2292	2366	2442	2518	2595	2674	2754	39
40	1797	1865	1935	2005	2076	2147	2220	2293	2368	2443	2519	2597	2675	2755	40
41	1798	1867	1936	2006	2077	2149	2221	2295	2369	2444	2521	2598	2677	2756	41
42	1799	1868	1937	2007	2078	2150	2222	2296	2370	2446	2522	2599	2678	2758	42
43	1800	1869	1938	2008	2079	2151	2224	2297	2371	2447	2523	2601	2679	2759	43
44	1801	1870	1939	2010	2081	2152	2225	2298	2373	2448	2524	2602	2681	2760	44
45	1802	1871	1941	2011	2082	2153	2226	2300	2374	2449	2526	2603	2682	2762	45
46	1804	1872	1942	2012	2083	2155	2227	2301	2375	2451	2527	2605	2683	2763	46
47	1805	1873	1943	2013	2084	2156	2229	2302	2376	2452	2528	2606	2684	2764	47
48	1806	1875	1944	2014	2085	2157	2230	2303	2378	2453	2530	2607	2686	2766	48
49	1807	1876	1945	2015	2087	2158	2131	2304	2379	2454	2531	2608	2687	2767	49
50	1808	1877	1946	2017	2088	2159	2232	2306	2380	2456	2532	2610	2688	2768	50
51	1809	1878	1948	2018	2089	2161	2233	2307	2381	2457	2533	2611	2690	2770	51
52	1810	1879	1949	2019	2090	2162	2235	2308	2383	2458	2535	2612	2691	2771	52
53	1811	1880	1950	2020	2091	2163	2236	2309	2384	2459	2536	2614	2692	2772	53
54	1813	1882	1951	2021	2093	2164	2237	2311	2385	2461	2537	2615	2694	2774	54
55	1814	1883	1952	2023	2094	2166	2238	2312	2386	2462	2539	2616	2695	2775	55
56	1815	1884	1953	2024	2095	2167	2239	2313	2388	2463	2540	2618	2696	2776	56
57	1816	1885	1955	2025	2096	2168	2241	2314	2389	2465	2541	2619	2698	2778	57
58	1817	1886	1956	2026	2097	2169	2242	2316	2390	2466	2542	2620	2699	2779	58
59	1818	1887	1957	2027	2099	2170	2243	2317	2391	2467	2544	2621	2700	2780	59
M.	28d.	29d.	30d.	31d.	32d.	33d.	34d.	35d.	36d.	37d.	38d.	39d.	40d.	41d.	M.

Table VI. Meridional Parts.

M.	42d.	43d.	44d.	45d.	46d.	47d.	48d.	49d.	50d.	51d.	52d.	53d.	54d.	55d.	M.
0	2782	2863	2946	3030	3116	3203	3292	3382	3475	3569	3665	3764	3865	3968	0
1	2783	2865	2947	3031	3117	3204	3293	3384	3476	3570	3667	3765	3866	3970	1
2	2784	2866	2949	3033	3119	3206	3295	3385	3478	3572	3669	3767	3868	3972	2
3	2786	2867	2950	3034	3120	3207	3296	3387	3479	3574	3670	3769	3870	3973	3
4	2787	2868	2951	3036	3121	3209	3298	3388	3481	3575	3672	3770	3872	3975	4
5	2789	2870	2953	3037	3123	3210	3299	3390	3482	3577	3673	3772	3873	3977	5
6	2790	2871	2954	3038	3124	3211	3301	3391	3484	3578	3675	3774	3875	3978	6
7	2791	2873	2956	3040	3126	3213	3302	3393	3485	3580	3677	3775	3877	3980	7
8	2793	2874	2957	3041	3127	3215	3304	3394	3487	3582	3678	3777	3878	3982	8
9	2794	2875	2958	3043	3128	3216	3305	3396	3489	3583	3680	3779	3880	3984	9
10	2795	2877	2960	3044	3130	3217	3307	3397	3490	3585	3682	3780	3882	3986	10
11	2797	2878	2961	3046	3132	3219	3308	3399	3492	3586	3683	3782	3883	3987	11
12	2798	2880	2963	3047	3133	3220	3310	3400	3493	3588	3685	3784	3885	3989	12
13	2799	2881	2964	3049	3134	3222	3311	3402	3495	3590	3686	3786	3887	3991	13
14	2801	2882	2965	3050	3136	3223	3313	3404	3496	3591	3688	3787	3889	3993	14
15	2802	2884	2967	3051	3137	3225	3314	3405	3498	3593	3690	3789	3890	3994	15
16	2803	2885	2968	3053	3139	3226	3316	3407	3500	3594	3691	3791	3892	3996	16
17	2805	2886	2970	3054	3140	3228	3317	3408	3501	3596	3693	3792	3894	3998	17
18	2806	2888	2971	3056	3142	3229	3319	3410	3503	3598	3695	3794	3895	4000	18
19	2807	2889	2972	3057	3143	3231	3320	3411	3504	3599	3696	3796	3897	4001	19
20	2809	2891	2974	3059	3145	3232	3322	3413	3506	3601	3698	3797	3899	4003	20
21	2810	2892	2975	3060	3146	3234	3323	3414	3507	3602	3700	3799	3901	4005	21
22	2811	2893	2977	3061	3147	3235	3325	3416	3509	3604	3701	3801	3902	4007	22
23	2813	2895	2978	3063	3149	3237	3326	3417	3511	3606	3703	3802	3904	4008	23
24	2814	2896	2979	3064	3150	3238	3328	3419	3512	3607	3704	3804	3906	4010	24
25	2816	2897	2981	3065	3152	3240	3329	3420	3514	3609	3706	3806	3907	4012	25
26	2817	2899	2982	3067	3153	3241	3331	3422	3515	3610	3708	3807	3909	4014	26
27	2818	2900	2984	3068	3155	3243	3332	3424	3517	3612	3709	3809	3911	4015	27
28	2820	2902	2985	3070	3156	3244	3334	3425	3518	3614	3711	3811	3913	4017	28
29	2821	2903	2986	3071	3158	3246	3335	3427	3520	3615	3713	3812	3914	4019	29
30	2822	2904	2988	3073	3159	3247	3337	3428	3521	3617	3714	3814	3916	4021	30
31	2824	2906	2989	3074	3160	3248	3338	3430	3523	3618	3716	3816	3918	4022	31
32	2825	2907	2991	3075	3162	3250	3340	3431	3525	3620	3718	3817	3920	4024	32
33	2826	2908	2992	3077	3163	3251	3341	3433	3526	3622	3719	3819	3921	4026	33
34	2828	2910	2993	3078	3165	3253	3343	3434	3528	3623	3721	3821	3923	4028	34
35	2829	2911	2995	3080	3166	3254	3344	3436	3529	3625	3722	3822	3925	4030	35
36	2830	2913	2996	3081	3168	3256	3346	3437	3531	3626	3724	3824	3926	4031	36
37	2832	2914	2998	3083	3169	3257	3347	3439	3532	3628	3726	3826	3928	4033	37
38	2833	2915	2999	3084	3171	3259	3349	3440	3534	3630	3727	3827	3930	4035	38
39	2835	2917	3000	3085	3172	3260	3350	3442	3536	3631	3729	3829	3932	4037	39
40	2836	2918	3002	3087	3174	3262	3352	3444	3537	3633	3731	3831	3933	4038	40
41	2837	2920	3003	3088	3175	3263	3353	3445	3539	3635	3732	3833	3935	4040	41
42	2839	2921	3005	3090	3176	3265	3355	3447	3540	3636	3734	3834	3937	4042	42
43	2840	2922	3006	3091	3178	3266	3356	3448	3542	3638	3736	3836	3939	4044	43
44	2841	2924	3007	3093	3179	3268	3358	3450	3544	3639	3737	3838	3940	4045	44
45	2843	2925	3009	3094	3181	3269	3359	3451	3545	3641	3739	3839	3942	4047	45
46	2844	2926	3010	3096	3182	3271	3361	3453	3547	3643	3741	3841	3944	4049	46
47	2845	2928	3012	3097	3184	3272	3362	3454	3548	3644	3742	3843	3945	4051	47
48	2847	2929	3013	3098	3185	3274	3364	3456	3550	3646	3744	3844	3947	4053	48
49	2848	2931	3014	3100	3187	3275	3365	3457	3551	3647	3746	3846	3949	4054	49
50	2850	2932	3016	3101	3188	3277	3367	3459	3553	3649	3747	3848	3951	4056	50
51	2851	2933	3017	3103	3190	3278	3368	3461	3555	3651	3749	3849	3952	4058	51
52	2852	2935	3019	3104	3191	3280	3370	3462	3556	3652	3751	3851	3954	4060	52
53	2854	2936	3020	3106	3193	3281	3372	3464	3558	3654	3752	3853	3956	4061	53
54	2855	2938	3022	3107	3194	3283	3373	3465	3559	3656	3754	3855	3958	4063	54
55	2856	2939	3023	3108	3195	3284	3375	3467	3561	3657	3756	3856	3959	4065	55
56	2858	2940	3024	3110	3197	3286	3376	3468	3563	3659	3757	3858	3961	4067	56
57	2859	2942	3026	3111	3198	3287	3378	3470	3564	3660	3759	3860	3963	4069	57
58	2861	2943	3027	3113	3200	3289	3379	3471	3566	3662	3760	3861	3965	4070	58
59	2862	2944	3029	3114	3201	3290	3381	3473	3567	3664	3762	3864	3966	4072	59
M	42d.	43d.	44d.	45d.	46d.	47d.	48d.	49d.	50d.	51d.	52d.	53d.	54d.	55d.	M.

M.	56d.	57d.	58d.	59d.	60d.	61d.	62d.	63d.	64d.	65d.	66d.	67d.	68d.	69d.	M.
0	4074	4183	4294	4409	4527	4049	4775	4905	5040	5179	5324	5474	5631	5795	0
1	4076	4185	4296	4411	4529	4651	4777	4907	5042	5181	5326	5477	5634	5797	1
2	4078	4186	4298	4413	4531	4653	4779	4909	5044	5184	5329	5479	5636	5800	2
3	4079	4188	4300	4415	4533	4656	4781	4912	5046	5186	5331	5482	5639	5803	3
4	4081	4190	4302	4417	4535	4658	4784	4914	5049	5188	5333	5484	5642	5806	4
5	4083	4192	4304	4419	4537	4660	4786	4916	5051	5191	5336	5487	5644	5809	5
6	4085	4194	4306	4421	4539	4662	4788	4918	5053	5193	5338	5489	5647	5811	6
7	4087	4196	4308	4423	4541	4664	4790	4920	5056	5195	5341	5492	5650	5814	7
8	4088	4197	4310	4425	4543	4666	4792	4923	5058	5198	5343	5495	5652	5817	8
9	4090	4199	4311	4427	4545	4668	4794	4925	5060	5200	5346	5497	5655	5820	9
10	4092	4201	4313	4429	4548	4670	4796	4927	5062	5203	5348	5500	5658	5823	10
11	4094	4203	4315	4431	4550	4672	4799	4929	5065	5205	5351	5502	5660	5825	11
12	4096	4205	4317	4433	4552	4674	4801	4932	5067	5207	5353	5505	5663	5828	12
13	4097	4207	4319	4435	4555	4676	4803	4934	5069	5210	5356	5508	5666	5831	13
14	4099	4208	4321	4436	4556	4678	4805	4936	5072	5212	5358	5510	5668	5834	14
15	4101	4210	4323	4438	4558	4680	4807	4938	5074	5215	5361	5513	5671	5837	15
16	4103	4212	4325	4440	4560	4682	4809	4940	5076	5217	5363	5515	5674	5840	16
17	4105	4214	4327	4442	4562	4685	4811	4943	5078	5219	5366	5518	5677	5842	17
18	4106	4216	4328	4444	4564	4687	4814	4945	5081	5222	5368	5520	5679	5845	18
19	4108	4218	4330	4446	4566	4689	4816	4947	5083	5224	5371	5523	5682	5848	19
20	4110	4220	4332	4448	4568	4691	4818	4949	5085	5227	5373	5526	5685	5851	20
21	4112	4221	4334	4450	4570	4693	4820	4952	5088	5229	5376	5528	5687	5854	21
22	4114	4223	4336	4452	4572	4695	4822	4954	5090	5231	5378	5531	5690	5857	22
23	4115	4225	4338	4454	4574	4697	4824	4956	5092	5234	5381	5533	5693	5859	23
24	4117	4227	4340	4456	4576	4699	4827	4958	5095	5236	5383	5536	5696	5862	24
25	4119	4229	4342	4458	4578	4701	4829	4960	5097	5239	5386	5539	5698	5865	25
26	4121	4231	4344	4460	4580	4703	4831	4963	5099	5241	5388	5541	5701	5868	26
27	4123	4233	4346	4462	4582	4705	4833	4965	5102	5243	5390	5544	5704	5871	27
28	4124	4234	4348	4464	4584	4707	4835	4967	5104	5246	5393	5546	5706	5874	28
29	4126	4236	4349	4466	4586	4710	4837	4969	5106	5248	5396	5549	5709	5876	29
30	4128	4238	4351	4468	4588	4712	4839	4972	5109	5251	5398	5552	5712	5879	30
31	4130	4240	4353	4470	4590	4714	4842	4974	5111	5253	5401	5554	5715	5882	31
32	4132	4242	4355	4472	4592	4716	4844	4976	5113	5255	5403	5557	5717	5885	32
33	4133	4244	4357	4474	4594	4718	4846	4978	5116	5258	5406	5560	5720	5888	33
34	4135	4246	4359	4476	4596	4720	4848	4981	5118	5260	5408	5562	5723	5891	34
35	4137	4247	4361	4478	4598	4723	4850	4983	5120	5263	5411	5565	5726	5894	35
36	4139	4249	4363	4480	4600	4724	4853	4985	5123	5265	5413	5567	5728	5896	36
37	4141	4251	4365	4482	4602	4726	4855	4987	5125	5267	5416	5570	5731	5899	37
38	4143	4253	4367	4484	4604	4728	4857	4990	5127	5270	5418	5573	5734	5902	38
39	4144	4255	4369	4486	4606	4731	4859	4992	5130	5272	5421	5575	5736	5905	39
40	4146	4257	4371	4488	4608	4733	4861	4994	5132	5275	5423	5578	5739	5908	40
41	4148	4259	4373	4490	4610	4735	4863	4996	5134	5277	5426	5581	5742	5911	41
42	4150	4261	4374	4492	4612	4737	4866	4999	5137	5280	5428	5583	5745	5914	42
43	4152	4262	4376	4494	4614	4739	4868	5001	5139	5282	5431	5586	5748	5917	43
44	4153	4264	4378	4496	4616	4741	4870	5003	5141	5284	5433	5588	5750	5920	44
45	4155	4266	4380	4498	4618	4743	4872	5005	5144	5287	5436	5591	5753	5922	45
46	4157	4268	4382	4500	4621	4745	4874	5008	5146	5289	5438	5594	5756	5925	46
47	4159	4270	4384	4502	4623	4747	4876	5010	5148	5292	5441	5596	5759	5928	47
48	4161	4272	4386	4504	4625	4750	4879	5012	5151	5294	5444	5599	5761	5931	48
49	4163	4274	4388	4506	4627	4752	4881	5014	5153	5297	5446	5602	5764	5934	49
50	4164	4276	4390	4508	4629	4754	4882	5017	5155	5299	5449	5604	5767	5937	50
51	4166	4277	4392	4509	4631	4756	4885	5019	5158	5302	5451	5607	5770	5940	51
52	4168	4279	4394	4511	4633	4758	4887	5021	5160	5304	5454	5610	5772	5943	52
53	4170	4281	4396	4513	4635	4760	4890	5024	5162	5306	5456	5612	5775	5946	53
54	4172	4283	4398	4515	4637	4762	4892	5026	5165	5309	5459	5615	5778	5949	54
55	4174	4285	4400	4517	4639	4764	4894	5028	5167	5311	5461	5618	5781	5951	55
56	4175	4287	4401	4519	4641	4767	4896	5030	5169	5314	5464	5620	5784	5954	56
57	4177	4289	4403	4521	4643	4769	4898	5033	5172	5316	5466	5623	5786	5957	57
58	4179	4291	4405	4523	4645	4771	4901	5035	5174	5319	5469	5626	5789	5960	58
59	4181	4293	4407	4525	4647	4773	4903	5037	5177	5321	5472	5628	5792	5963	59
M.	56d	57d.	58d.	59d	60d.	61d.	62d.	63d.	64d.	65d.	66d.	67d.	68d.	69d.	M.

Table VI. Meridional Parts.

M.	42d.	43d.	44d.	45d.	46d.	47d.	48d.	49d.	50d.	51d.	52d.	53d.	54d.	55d.	M.
0	2782	2863	2946	3030	3116	3203	3292	3382	3475	3569	3665	3764	3865	3968	0
1	2783	2865	2947	3031	3117	3204	3293	3384	3476	3570	3667	3765	3866	3970	1
2	2784	2866	2949	3033	3119	3206	3295	3385	3478	3572	3669	3767	3868	3972	2
3	2786	2867	2950	3034	3120	3207	3296	3387	3479	3574	3670	3769	3870	3973	3
4	2787	2869	2951	3036	3121	3209	3298	3388	3481	3575	3672	3770	3872	3975	4
5	2789	2870	2953	3037	3123	3210	3299	3390	3482	3577	3673	3772	3873	3977	5
6	2790	2871	2954	3038	3124	3212	3301	3391	3484	3578	3675	3774	3875	3978	6
7	2791	2873	2956	3040	3126	3213	3302	3393	3485	3580	3677	3775	3877	3980	7
8	2793	2874	2957	3041	3127	3215	3304	3394	3487	3582	3678	3777	3878	3982	8
9	2794	2875	2958	3043	3129	3216	3305	3396	3489	3583	3680	3779	3880	3984	9
10	2795	2877	2960	3044	3130	3217	3307	3397	3490	3585	3682	3780	3882	3986	10
11	2797	2878	2961	3046	3132	3219	3308	3399	3492	3586	3683	3782	3883	3987	11
12	2798	2880	2963	3047	3133	3220	3310	3400	3493	3588	3685	3784	3885	3989	12
13	2799	2881	2964	3048	3134	3222	3311	3402	3495	3590	3686	3786	3887	3991	13
14	2801	2882	2965	3050	3136	3223	3313	3404	3496	3591	3688	3787	3889	3993	14
15	2802	2884	2967	3051	3137	3225	3314	3405	3498	3593	3690	3789	3890	3994	15
16	2803	2885	2968	3053	3139	3226	3316	3407	3500	3594	3691	3791	3892	3996	16
17	2805	2886	2970	3054	3140	3228	3317	3408	3501	3596	3693	3792	3894	3998	17
18	2806	2888	2971	3056	3142	3229	3319	3410	3503	3598	3695	3794	3895	4000	18
19	2807	2889	2972	3057	3143	3231	3320	3411	3504	3599	3696	3796	3897	4001	19
20	2809	2891	2974	3058	3145	3232	3342	3413	3506	3601	3698	3797	3899	4003	20
21	2810	2892	2975	3060	3146	3434	3323	3414	3507	3602	3700	3799	3901	4005	21
22	2811	2893	2977	3061	3147	3235	3325	3416	3509	3604	3701	3801	3902	4007	22
23	2813	2895	2978	3063	3149	3237	3326	3417	3511	3606	3703	3802	3904	4008	23
24	2814	2896	2979	3064	3150	3238	3328	3419	3512	3607	3704	3804	3906	4010	24
25	2816	2897	2981	3065	3152	3240	3329	3420	3514	3609	3706	3806	3907	4012	25
26	2817	2899	2982	3067	3153	3241	3331	3422	3515	3610	3708	3807	3909	4014	26
27	2818	2900	2984	3068	3155	3243	3332	3424	3517	3612	3709	3809	3911	4015	27
28	2820	2902	2985	3070	3156	3244	3334	3425	3518	3614	3711	3811	3913	4017	28
29	2821	2903	2986	3071	3158	3246	3335	3427	3520	3615	3713	3812	3914	4019	29
30	2822	2904	2988	3073	3159	3247	3337	3428	3521	3617	3714	3814	3916	4021	30
31	2824	2906	2989	3074	3160	3248	3338	3430	3523	3618	3716	3816	3918	4022	31
32	2825	2907	2991	3075	3162	3250	3340	3431	3525	3620	3718	3817	3920	4024	32
33	2826	2908	2992	3077	3163	3251	3341	3433	3526	3622	3719	3819	3921	4026	33
34	2828	2910	2993	3078	3165	3253	3343	3434	3528	3623	3721	3821	3923	4028	34
35	2829	2911	2995	3080	3166	3254	3344	3436	3529	3625	3722	3822	3925	4030	35
36	2830	2913	2996	3081	3168	3256	3346	3437	3531	3626	3724	3824	3926	4031	36
37	2832	2914	2998	3083	3169	3257	3347	3439	3532	3628	3726	3826	3928	4033	37
38	2833	2915	2999	3084	3171	3259	3349	3440	3534	3630	3727	3827	3930	4035	38
39	2835	2917	3000	3085	3172	3260	3350	3442	3536	3631	3729	3829	3932	4037	39
40	2836	2918	3002	3087	3174	3262	3352	3444	3537	3633	3731	3831	3933	4038	40
41	2837	2920	3003	3088	3175	3263	3353	3445	3539	3635	3732	3833	3935	4040	41
42	2839	2921	3005	3090	3176	3265	3355	3447	3540	3636	3734	3834	3937	4042	42
43	2840	2922	3006	3091	3178	3266	3356	3448	3542	3638	3736	3836	3939	4044	43
44	2841	2924	3007	3093	3179	3268	3358	3450	3544	3639	3737	3838	3940	4045	44
45	2843	2925	3009	3094	3181	3269	3359	3451	3545	3641	3739	3839	3942	4047	45
46	2844	2926	3010	3096	3182	3271	3361	3453	3547	3643	3741	3841	3944	4049	46
47	2845	2928	3012	3097	3184	3272	3362	3454	3548	3644	3742	3843	3945	4051	47
48	2847	2929	3013	3098	3185	3274	3364	3456	3550	3646	3744	3844	3947	4053	48
49	2848	2931	3014	3100	3187	3275	3365	3457	3551	3647	3746	3846	3949	4054	49
50	2850	2932	3016	3101	3188	3277	3367	3459	3553	3649	3747	3848	3951	4056	50
51	2851	2933	3017	3103	3190	3278	3368	3461	3555	3651	3749	3849	3952	4058	51
52	2852	2935	3019	3104	3191	3280	3370	3462	3556	3652	3751	3851	3954	4060	52
53	2854	2936	3020	3106	3193	3281	3372	3464	3558	3654	3752	2853	3956	4061	53
54	2855	2938	3022	3107	3194	3283	3373	3465	3559	3656	3754	3855	3958	4063	54
55	2856	2939	3023	3108	3195	3284	3375	3467	3561	3657	3756	3856	3959	4065	55
56	2858	2940	3024	3110	3197	3286	3376	3468	3563	3659	3757	3858	3961	4067	56
57	2859	2942	3026	3111	3198	3287	3378	3470	3564	3660	3759	3860	3963	4069	57
58	2861	2943	3027	3113	3200	3289	3379	3471	3566	3662	3760	3861	3965	4070	58
59	2862	2944	3020	3114	3201	3290	3381	3473	3567	3664	3762	3864	3966	4072	59
M	42d.	43d.	44d.	45d.	46d.	47d.	48d.	49d.	50d.	51d.	52d.	53d.	54d.	55d.	M.

TABLE VI. MERIDIONAL PARTS.

M.	56d.	57d.	58d.	59d.	60d.	61d.	62d.	63d.	64d.	65d.	66d.	67d.	68d.	69d.	M.
0	4074	4183	4294	4409	4527	4049	4775	4905	5040	5179	5324	5474	5631	5795	0
1	4076	4185	4296	4411	4529	4651	4777	4907	5042	5181	5326	5477	5634	5797	1
2	4078	4186	4298	4413	4531	4653	4779	4909	5044	5184	5329	5479	5636	5800	2
3	4079	4188	4300	4415	4533	4656	4781	4912	5046	5186	5331	5482	5639	5803	3
4	4081	4190	4302	4417	4535	4658	4784	4914	5049	5188	5333	5484	5642	5806	4
5	4083	4192	4304	4419	4537	4660	4786	4916	5051	5191	5336	5487	5644	5809	5
6	4085	4194	4306	4421	4539	4662	4788	4918	5053	5193	5338	5489	5647	5811	6
7	4087	4196	4308	4423	4541	4664	4790	4920	5056	5195	5341	5492	5650	5814	7
8	4088	4197	4310	4425	4543	4666	4792	4923	5058	5198	5343	5495	5652	5817	8
9	4090	4199	4311	4427	4545	4668	4794	4925	5060	5200	5346	5497	5655	5820	9
10	4092	4201	4313	4429	4548	4670	4796	4927	5062	5203	5348	5500	5658	5823	10
11	4094	4203	4315	4431	4550	4672	4799	4929	5065	5205	5351	5502	5660	5825	11
12	4096	4205	4317	4433	4552	4674	4801	4932	5067	5207	5353	5505	5663	5828	12
13	4097	4207	4319	4435	4555	4676	4803	4934	5069	5210	5356	5508	5666	5831	13
14	4099	4208	4321	4436	4556	4678	4805	4936	5072	5212	5358	5510	5668	5834	14
15	4101	4210	4323	4438	4558	4680	4807	4938	5074	5215	5361	5513	5071	5837	15
16	4103	4212	4325	4440	4560	4682	4809	4940	5076	5217	5363	5515	5674	5840	16
17	4105	4214	4327	4442	4562	4685	4811	4943	5078	5219	5366	5518	5677	5842	17
18	4106	4216	4328	4444	4564	4687	4814	4945	5081	5222	5368	5520	5679	5845	18
19	4108	4218	4330	4446	4566	4689	4816	4947	5083	5224	5371	5523	5682	5848	19
20	4110	4220	4332	4448	4568	4691	4818	4949	5085	5227	5373	5526	5685	5851	20
21	4112	4221	4334	4450	4570	4693	4820	4952	5088	5229	5376	5528	5687	5854	21
22	4114	4223	4336	4452	4572	4695	4822	4954	5090	5231	5378	5531	5690	5857	22
23	4115	4225	4338	4454	4574	4697	4824	4956	5092	5234	5381	5533	5693	5859	23
24	4117	4227	4340	4456	4576	4699	4827	4958	5095	5236	5383	5536	5696	5862	24
25	4119	4229	4342	4458	4578	4701	4829	4960	5097	5239	5386	5539	5698	5865	25
26	4121	4231	4344	4460	4580	4703	4831	4963	5099	5241	5388	5541	5701	5868	26
27	4123	4233	4346	4462	4582	4705	4833	4965	5102	5243	5390	5544	5704	5871	27
28	4124	4234	4348	4464	4584	4707	4835	4967	5104	5246	5393	5546	5706	5874	28
29	4126	4236	4349	4466	4586	4710	4837	4969	5106	5248	5396	5549	5709	5876	29
30	4128	4238	4351	4468	4588	4712	4839	4972	5109	5251	5398	5552	5712	5879	30
31	4130	4240	4353	4470	4590	4714	4842	4974	5111	5253	5401	5554	5715	5882	31
32	4132	4242	4355	4472	4592	4716	4844	4976	5113	5255	5403	5557	5717	5885	32
33	4133	4244	4357	4474	4594	4718	4846	4978	5116	5258	5406	5560	5720	5888	33
34	4135	4246	4359	4476	4596	4720	4848	4981	5118	5260	5408	5562	5723	5891	34
35	4137	4247	4361	4478	4598	4723	4850	4983	5120	5263	5411	5565	5726	5894	35
36	4139	4249	4363	4480	4600	4724	4853	4985	5123	5265	5413	5567	5728	5896	36
37	4141	4251	4365	4482	4602	4726	4855	4987	5125	5267	5416	5570	5731	5899	37
38	4143	4253	4367	4484	4604	4728	4857	4990	5127	5270	5418	5573	5734	5902	38
39	4144	4255	4369	4486	4606	4731	4859	4992	5130	5272	5421	5575	5736	5905	39
40	4146	4257	4371	4488	4608	4733	4861	4994	5132	5275	5423	5578	5739	5908	40
41	4148	4259	4373	4490	4610	4735	4863	4996	5134	5277	5426	5581	5742	5911	41
42	4150	4261	4374	4492	4612	4737	4866	4999	5137	5280	5428	5583	5745	5914	42
43	4152	4262	4376	4494	4614	4739	4868	5001	5139	5282	5431	5586	5748	5917	43
44	4153	4264	4378	4496	4616	4741	4870	5003	5141	5284	5433	5588	5750	5920	44
45	4155	4266	4380	4498	4618	4743	4872	5005	5144	5287	5436	5591	5753	5922	45
46	4157	4268	4382	4500	4621	4745	4874	5008	5146	5289	5438	5594	5756	5925	46
47	4159	4270	4384	4502	4623	4747	4876	5010	5148	5292	5441	5596	5759	5928	47
48	4161	4272	4386	4504	4625	4750	4879	5012	5151	5294	5444	5599	5761	5931	48
49	4163	4274	4388	4506	4627	4752	4881	5014	5153	5297	5446	5602	5764	5934	49
50	4164	4276	4390	4508	4629	4754	4882	5017	5155	5299	5449	5604	5767	5937	50
51	4166	4277	4392	4509	4631	4756	4885	5019	5158	5302	5451	5607	5770	5940	51
52	4168	4279	4394	4511	4633	4758	4887	5021	5160	5304	5454	5610	5772	5943	52
53	4170	4281	4396	4513	4635	4760	4890	5024	5162	5306	5456	5612	5775	5946	53
54	4172	4283	4398	4515	4637	4762	4892	5026	5165	5309	5459	5615	5778	5949	54
55	4174	4285	4400	4517	4639	4764	4894	5028	5167	5311	5461	5618	5781	5951	55
56	4175	4287	4401	4519	4641	4767	4896	5030	5169	5314	5464	5620	5784	5954	56
57	4177	4289	4403	4521	4643	4769	4898	5033	5172	5316	5466	5623	5786	5957	57
58	4179	4291	4405	4523	4645	4771	4901	5035	5174	5319	5469	5626	5789	5960	58
59	4181	4293	4407	4525	4647	4773	4903	5037	5177	5321	5472	5628	5792	5963	59
M.	56d	57d.	58d.	59d	60d.	61d.	62d.	63d.	64d.	65d.	66d.	67d.	68d	69d.	M.

M.	70d.	71d.	72d.	73d.	74d.	75d.	76d.	77d.	78d.	79d.	80d.	81d.	82d.	83d.	M.
0	5966	6146	6335	6535	6746	6970	7210	7467	7745	8046	8375	8739	9146	9606	0
1	5969	6149	6338	6538	6749	6974	7214	7472	7749	8051	8381	8746	9153	9614	1
2	5972	6152	6341	6541	6753	6978	7218	7476	7754	8056	8387	8752	9160	9622	2
3	5975	6155	6345	6545	6757	6982	7223	7481	7759	8062	8393	8758	9167	9631	3
4	5978	6158	6348	6548	6760	6986	7227	7485	7764	8067	8398	8765	9174	9639	4
5	5981	6161	6351	6552	6764	6990	7231	7490	7769	8072	8404	8771	9182	9647	5
6	5984	6164	6354	6555	6768	6994	7235	7494	7774	8077	8410	8778	9189	9656	6
7	5987	6167	6358	6559	6771	6998	7239	7499	7778	8083	8416	8784	9196	9664	7
8	5989	6170	6361	6562	6775	7001	7243	7503	7783	8088	8422	8791	9204	9672	8
9	5992	6174	6364	6565	6779	7005	7248	7507	7788	8093	8427	8797	9211	9681	9
10	5995	6177	6367	6569	6782	7009	7252	7512	7793	8099	8433	8804	9218	9689	10
11	5998	6180	6371	6572	6786	7013	7256	7516	7798	8104	8439	8810	9225	9697	11
12	6001	6183	6374	6576	6790	7017	7260	7521	7803	8109	8445	8817	9233	9706	12
13	6004	6186	6377	6579	6793	7021	7264	7525	7808	8115	8451	8823	9240	9714	13
14	6007	6189	6381	6583	6797	7025	7268	7530	7813	8120	8457	8830	9248	9723	14
15	6010	6192	6384	6586	6801	7029	7273	7535	7817	8125	8463	8836	9255	9731	15
16	6013	6195	6387	6590	6804	7033	7277	7539	7822	8131	8469	8843	9262	9740	16
17	6016	6198	6390	6593	6808	7037	7281	7544	7827	8136	8475	8849	9270	9748	17
18	6019	6201	6394	6597	6812	7041	7285	7548	7832	8141	8480	8856	9277	9757	18
19	6022	6205	6397	6600	6816	7045	7289	7553	7837	8147	8486	8863	9285	9765	19
20	6025	6208	6400	6603	6819	7048	7294	7557	7842	8152	8492	8869	9292	9774	20
21	6028	6211	6404	6607	6823	7052	7298	7562	7847	8158	8498	8876	9300	9783	21
22	6031	6214	6407	6610	6826	7056	7302	7566	7852	8163	8504	8883	9307	9791	22
23	6034	6217	6410	6614	6830	7060	7306	7571	7857	8168	8510	8889	9315	9800	23
24	6037	6220	6413	6617	6834	7064	7311	7576	7862	8174	8516	8896	9322	9809	24
25	6040	6223	6417	6621	6838	7068	7315	7580	7867	8179	8522	8903	9330	9817	25
26	6043	6227	6420	6624	6841	7072	7319	7585	7872	8185	8528	8909	9338	9826	26
27	6046	6230	6423	6628	6845	7076	7323	7589	7877	8190	8534	8916	9345	9835	27
28	6049	6233	6427	6631	6849	7080	7328	7594	7882	8196	8540	8923	9353	9844	28
29	6052	6236	6430	6635	6853	7084	7332	7598	7887	8201	8546	8930	9360	9852	29
30	6055	6239	6433	6639	6856	7088	7336	7603	7892	8207	8552	8936	9368	9861	30
31	6058	6242	6437	6642	6860	7092	7341	7608	7897	8212	8558	8943	9376	9870	31
32	6061	6245	6440	6646	6864	7096	7345	7612	7902	8218	8564	8950	9384	9879	32
33	6064	6249	6443	6649	6868	7100	7349	7617	7907	8223	8571	8957	9391	9888	33
34	6067	6252	6447	6653	6871	7104	7353	7622	7912	8229	8577	8963	9399	9897	34
35	6070	6255	6450	6656	6875	7108	7358	7626	7917	8234	8583	8970	9407	9906	35
36	6073	6258	6453	6660	6879	7112	7362	7631	7922	8240	8589	8977	9414	9915	36
37	6076	6261	6457	6663	6883	7116	7366	7636	7927	8245	8595	8984	9422	9924	37
38	6079	6264	6460	6667	6886	7120	7371	7640	7932	8251	8601	8991	9430	9933	38
39	6082	6268	6463	6670	6890	7124	7375	7645	7937	8256	8607	8998	9438	9942	39
40	6085	6271	6467	6674	6894	7128	7379	7650	7942	8262	8614	9005	9446	9951	40
41	6088	6274	6470	6677	6898	7132	7384	7654	7948	8267	8620	9012	9453	9960	41
42	6091	6277	6473	6681	6901	7136	7388	7659	7953	8273	8626	9018	9461	9969	42
43	6094	6280	6477	6685	6905	7140	7392	7664	7958	8279	8632	9025	9469	9978	43
44	6097	6284	6480	6688	6909	7145	7397	7668	7963	8284	8638	9032	9477	9987	44
45	6100	6287	6484	6692	6913	7149	7401	7673	7968	8290	8645	9039	9485	9996	45
46	6103	6290	6487	6695	6917	7153	7406	7678	7973	8296	8651	9046	9493	10010	46
47	6106	6293	6490	6699	6920	7157	7410	7683	7978	8301	8657	9053	9501	10015	47
48	6109	6296	6494	6702	6924	7161	7414	7687	7983	8307	8663	9060	9509	10024	48
49	6112	6299	6497	6706	6028	7165	7419	7692	7989	8312	8670	9067	9517	10033	49
50	6115	6303	6500	6710	6932	7169	7423	7697	7994	8318	8676	9074	9525	10043	50
51	6118	6306	6504	6713	6936	7173	7427	7702	7999	8324	8682	9081	9533	10052	51
52	6121	6309	6507	6717	6940	7177	7432	7706	8004	8329	8688	9089	9541	10061	52
53	6124	6312	6511	6720	6943	7181	7436	7711	8009	8335	8695	9096	9549	10071	53
54	6127	6316	6514	6724	6947	7185	7441	7716	8014	8341	8701	9103	9557	10080	54
55	6130	6319	6517	6728	6951	7190	7445	7721	8020	8347	8707	9110	9565	10089	55
56	6134	6322	6521	6731	6955	7194	7450	7725	8025	8352	8714	9117	9573	10099	56
57	6137	6325	6524	6735	6959	7198	7454	7730	8030	8358	8720	9124	9581	10108	57
58	6140	6328	6528	6739	6963	7202	7458	7735	8035	8364	8726	9131	9590	10118	58
59	6143	6332	6531	6742	6967	7206	7462	7740	8041	8370	8733	9138	9598	10127	59
M.	70d.	71d.	72d.	73d.	74d.	75d.	76d.	77d.	78d.	79d.	80d.	81d.	82d.	83d.	M.

A TABLE

OF THE

SUN's DECLINATION,

For the YEARS 1807, 1811, 1815, 1819,

Being the Third after LEAP YEAR.

Days.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	South	South	South	North	North	North	North	North	North	South	South	South
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
1	23. 4	17.16	7.49	4.18	14.53	21.58	23.11	18.13	8.33	2.55	14.14	21.44
2	22.59	16.59	7.26	4.41	15.11	22. 7	23. 7	17.58	8.11	3.19	14.34	21.53
3	22.54	16.42	7. 3	5. 4	15.29	22.14	23. 3	17.43	7.49	3.42	14.53	22. 2
4	22.48	16.24	6.40	5.27	15.46	22.22	22.58	17.27	7.27	4. 5	15.12	22.11
5	22.42	16. 6	6.17	5.50	16. 4	22.29	22.53	17.11	7. 5	4.29	15.30	22.19
6	22.35	15.48	5.54	6.13	16.21	22.36	22.47	16.55	6.43	4.52	15.48	22.27
7	22.28	15.29	5.31	6.35	16.38	22.42	22.41	16.39	6.20	5.15	16. 7	22.34
8	22.20	15.11	5. 7	6.58	16.54	22.48	22.35	16.22	5.58	5.38	16.24	22.41
9	22.12	14.52	4.44	7.20	17.11	22.53	22.28	16. 5	5.35	6. 1	16.42	22.47
10	22. 3	14.32	4.21	7.4	17.27	22.58	22.21	15.48	5.13	6.24	16.59	22.53
11	21.54	14.13	3.57	8. 5	17.43	23. 3	22.14	15.30	4.50	6.47	17.16	22.58
12	21.45	13.53	3.34	8.27	17.58	23. 7	22. 6	15.12	4.27	7. 9	17.33	23. 3
13	21.35	13.33	3.10	8.49	18.13	23.11	21.57	14.54	4. 4	7.32	18.49	23. 8
14	21.25	13.13	2.46	9.10	18.28	23.15	21.49	14.36	3.41	7.54	18. 5	23 12
15	21.15	12.53	2.23	9.32	18.43	23.18	21.40	14.18	3.18	8.17	18.21	23.15
16	21. 3	12.32	1.59	9.54	18.57	23.20	21.30	13.59	2.55	8.39	18.36	23.19
17	20.52	12.11	1.35	10.15	19.11	23.23	21.21	13.40	2.32	9. 1	18.51	23.21
18	20.40	11.50	1.12	10.36	19.24	23.25	21.11	13.21	2. 9	9.23	19. 6	23.24
19	20.28	11.29	0.48	10.57	19.38	23.26	21. 0	13. 2	1.45	9.45	19.20	23.25
20	20.14	11. 8	0.24	11.18	19.51	23.27	20.49	12.42	1.22	10. 7	19.34	23.27
21	20. 2	10.46	0. 1S.	11.38	20. 3	23.28	20.38	12.22	0.59	10.28	19.48	23.27
22	19.49	10.25	0.23N.	11.59	20.15	23.28	20.27	12. 2	0.35	10.50	20. 1	23.28
23	19.35	10. 3	0.47	12.19	20.27	23.28	20.15	11.42	0.12N.	11.11	20.14	23.28
24	19.21	9.41	1.10	12.39	20.39	23.27	20. 3	11.22	0.12S.	11.32	20.27	23.27
25	19. 7	9.19	1.34	12.59	20.50	23.26	19.50	11. 1	0.35	11.53	20.39	23.26
26	18.52	8.56	1.57	13.18	21. 1	23.24	19.37	10.41	0.58	12.14	20.51	23.24
27	18.37	8.34	2.21	13.37	21.11	23.22	19.24	10.20	1.22	12.35	21. 2	23.22
28	18.21	8.12	2.44	13.57	21.21	23.20	19.11	9.59	1.45	12.53	21.13	23.20
29	18. 6		3. 8	14.15	21.31	23.17	18.57	9.38	2. 9	13.15	21.24	23.17
30	17.49		3.31	14.34	21.41	23.14	18.43	9.16	2.32	13.35	21.34	23.13
31	17.33		3.55		21.50		18.28	8.55		13.55		23.10

A TABLE

OF THE

SUN's DECLINATION,

For the YEARS 1808, 1812, 1816,

Each being LEAP YEAR.

Days.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	South	S h	South	North	North	North	North	North	North	South	South	South
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
1	23. 5	17.20	7.31	4.35	15. 6	22. 5	23. 8	18. 2	8.17	3.13	14.29	21.51
2	23. 0	17. 3	7. 9	4.59	15.24	22.13	23. 4	17.47	7.55	3.36	14.48	22.00
3	22.55	16.46	6.46	5.22	15.42	22.20	22.59	17.31	7.33	4.00	15. 7	22. 9
4	22 49	16.28	6.23	5.44	16.00	22.27	22.54	17.15	7.11	4.23	15.26	22.17
5	22.43	16.10	5.59	6. 7	16.17	22.34	22.48	17. 0	6.48	4.46	15.44	22.25
6	22.36	15.52	5.36	6.30	16.34	22.40	22.43	16.43	6.26	5. 9	16. 2	22.32
7	22.29	15.34	5.13	6.52	16.51	22.46	22.36	16.26	6. 4	5.32	16.20	22.39
8	22.22	15.15	4.50	7.15	17. 7	22.52	22.30	16. 9	5.41	5.55	16.37	22.45
9	22.14	14.56	4.26	7.37	17.23	22.57	22.23	15.52	5.18	6.18	16.55	22.51
10	22. 5	14.37	4. 3	7.59	17.39	23. 2	22.15	15.35	4.56	6.41	17.12	22.57
11	21.57	14.18	3.39	8.22	17.54	23. 6	22. 8	15.17	4.33	7. 4	17.28	23. 2
12	21.47	13.58	3.16	8.43	18.10	23.10	21.59	14.59	4.10	7.26	17.45	23. 7
13	21.38	13.38	2.52	9. 5	18.25	23.14	21.51	14.41	3.47	7.49	18. 1	23.11
14	21.28	13.18	2.28	9.27	18.39	23.17	21.42	14.22	3 24	8.11	18.17	23.15
15	21.17	12 58	2. 5	9.48	18.53	23.20	21.33	14. 4	3. 1	8.33	18.32	23.18
16	21. 6	12.37	1.41	10.10	19. 7	23.22	21.23	13.45	2.38	8.56	18.47	23.21
17	20.55	12.16	1.17	10.31	19.21	23.24	21.13	13.26	2.14	9.18	19. 2	23.23
18	20.43	11.56	0.54	10.52	19.34	23.26	21. 3	13. 6	1.51	9.40	19.17	23.25
19	20.31	11.34	0.30	11.13	19.47	23.27	20.52	12.47	1.28	10. 1	19.31	23.26
20	20.18	11.13	0.06S.	11.33	20. 0	23.27	20.41	12.27	1. 4	10.23	19.45	23.27
21	20. 6	10.52	0.17N.	11.54	20.12	23.28	20.29	12. 7	0.41	10.45	19.58	23.28
22	19.52	10.30	0.41	12.14	20.24	23.28	20.18	11.47	0.18N.	11. 6	20.11	23.28
23	19.39	10. 8	1. 5	12.34	20.36	23.27	20. 6	11.27	0. 6S.	11.27	20.24	23.27
24	19.25	9.46	1.28	12.54	20.47	23.26	19.53	11. 6	0.29	11.48	20.36	23.26
25	19.10	9.24	1.52	13.13	20.58	23.25	19.40	10.46	0.53	12. 9	20.48	23.25
26	18.56	9. 2	2.15	13.33	21. 9	23.23	19.27	10.25	1.16	12.30	20.59	23.23
27	18.40	8.39	2.39	13.52	21.19	23.21	19.14	10. 4	1.40	12.50	21.10	23.20
28	18.25	8.17	3. 2	14.11	21.29	23.18	19. 0	9.43	2. 3	13.10	21.21	23.18
29	18. 9	7.54	3.26	14.30	21.39	23.15	18.46	9.21	2.26	13.30	21.32	23.14
30	17.53		3.49	14.48	21.48	23.12	18.32	9. 0	2.50	13.50	21.41	23.10
31	17.37		4.12		21.56		18.17	8.38		14.10		23. 6

A TABLE

OF THE

SUN's DECLINATION,

For the YEARS 1809, 1813, 1817,

Being the Firſt after LEAP-YEAR.

Days.	Jan.	Feb.	March	April	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	South	South	South	North	North	North	North	North	North	South	South	South
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
1	23. 2	17. 7	7.37	4.30	15. 2	22. 3	23. 9	18. 6	8.22	3. 7	14.24	21.49
2	22.56	16.50	7.14	4.53	15.20	22.11	23. 5	17.51	8. 0	3.31	14.43	21.58
3	22.51	16.33	6.51	5.16	15.38	22.18	23. 0	17.35	7.38	3.54	15. 2	22. 7
4	22.45	16.15	6.28	5.39	15.55	22.26	22.55	17.19	7.16	4.17	15.21	22.15
5	22.38	15.57	6. 5	6. 2	16.13	22.34	22.50	17. 3	6.54	4.40	15.40	22.23
6	22.31	15.39	5.42	6.24	16.30	22.39	22.44	16.47	6.31	5. 4	15.58	22.30
7	22.24	15.20	5.19	6.47	16.46	22.45	22.38	16.30	6. 9	5.27	16.16	22.37
8	22.16	15. 1	4.55	7. 9	17. 3	22.51	22.31	16.13	5.46	5.50	16.33	22.44
9	22. 8	14.42	4.32	7.32	17.19	22.56	22.25	15.56	5.24	6.13	16.51	22.50
10	21.59	14.23	4. 9	7.54	17.35	23. 1	22.17	15.39	5. 1	6.35	17. 8	22.56
11	21.50	14. 3	3.45	8.16	17.51	23. 5	22.10	15.21	4.38	6.58	17.25	23. 1
12	21.40	13.43	3.21	8.38	18. 6	23. 9	22. 2	15. 3	4.15	7.21	17.41	23. 6
13	21.30	13.23	2.58	9.00	18.21	23.13	21.53	14.45	3.52	7.43	17.57	23.10
14	21.20	13. 3	2.34	9.22	18 36	23.16	21.44	14.27	3.29	8. 6	18.13	23.14
15	21. 9	12.42	2.11	9.43	18.50	23.19	21.35	14. 8	3. 6	8.28	18.29	23.17
16	20.58	12.22	1.47	10. 5	19. 4	23.22	21.25	13.49	2.43	8.50	18.44	23.20
17	20.46	12. 1	1.23	10.26	19.18	23.24	21.16	13.30	2.20	9.13	18.59	23.23
18	20.34	11.40	0.59	10.47	19.31	23.25	21. 5	13.11	1.57	9.35	19.13	23.25
19	20.22	11.18	0.36	11. 8	19.44	23.27	20.55	12.52	1.33	9.56	19.27	23.26
20	20. 9	10.57	0.12S.	11.28	19.57	23.27	20.44	12.32	1.10	10.18	19.41	23.27
21	19.56	10.35	0.12N.	11.49	20.10	23.28	20.32	12.12	0.47N.	10.40	19.55	23.28
22	19.42	10.13	0.35	12. 9	20.22	23.29	20.21	11.52	0.23N.	11. 1	20. 8	23.28
23	19.28	9.52	0.59	12.29	20.33	23.27	20. 9	11.32	0. 0	11.22	20.21	23.27
24	19.14	9.29	0.23	12.49	20.45	23.26	19.56	11.11	0.24S.	11.43	20.33	23.27
25	18.59	9. 7	1.46	13. 9	20.56	23.25	19.44	10.51	0.47	12. 4	20.45	23.25
26	18.44	8.45	2.10	13.28	21. 6	23.23	19.30	10.30	1.10	12.25	20.57	23.23
27	18.29	8.22	2.33	13.47	21.17	23.21	19.17	10. 9	1.34	12.45	21. 8	23.21
28	18.13	8. 0	2.57	14. 6	21.27	23.19	19. 3	9.48	1.57	13. 5	21.19	23.18
29	17.57		3.20	14.25	21.36	23.16	18.49	9.27	2.21	13.25	21.29	23.15
30	17.41		3.43	14.44	21.45	23.13	18.35	9. 5	2.44	13.45	21.39	23.11
31	17.24		4. 7		21.54		18.21	8.44		14. 5		23. 7

A TABLE

OF THE

SUN's DECLINATION,

For the YEARS 1808, 1812, 1816,

Each being LEAP YEAR.

Days.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	South	S h	South	North	North	North	North	North	North	South	South	South
	° '	° '	° '	° '	° '	° '	° '	° '	° '	° '	° '	° '
1	23. 5	17.20	7.31	4.35	15. 6	22. 5	23. 8	18. 2	8.17	3.13	14.29	21.51
2	23. 0	17. 3	7. 9	4.59	15.24	22.13	23. 4	17.47	7.55	3.36	14.48	22.00
3	22.55	16.46	6.46	5.22	15.42	22.20	22.59	17.31	7.33	4.00	15. 7	22. 9
4	22 49	16.28	6.23	5.44	16.00	22.27	22.54	17.15	7.11	4.23	15.26	22.17
5	22.43	16.10	5.59	6. 7	16.17	22.34	22.48	17. 0	6.48	4.46	15.44	22.25
6	22.36	15.52	5.36	6.30	16.34	22.40	22.43	16.43	6.26	5. 9	16. 2	22.32
7	22.29	15.34	5.13	6.52	16.51	22.46	22.36	16.26	6. 4	5.32	16.20	22.39
8	22.22	15.15	4.50	7.15	17. 7	22.52	22.30	16. 9	5.41	5.55	16.37	22.45
9	22.14	14.56	4.26	7.37	17.23	22.57	22.23	15.52	5.18	6.18	16.55	22.51
10	22. 5	14.37	4. 3	7.59	17.39	23. 2	22.15	15.35	4.56	6.41	17.12	22.57
11	21.57	14.18	3.39	8.22	17.54	23. 6	22. 8	15.17	4.33	7. 4	17.28	23. 2
12	21.47	13.58	3.16	8.43	18.10	23.10	21.59	14.59	4.10	7.26	17.45	23. 7
13	21.38	13.38	2.52	9. 5	18.25	23.14	21.51	14.41	3.47	7.49	18. 1	23.11
14	21.28	13.18	2.28	9.27	18.39	23.17	21.42	14.22	3 24	8.11	18.17	23.15
15	21.17	12 58	2. 5	9.48	18.53	23.20	21.33	14. 4	3. 1	8.33	18.32	23.18
16	21. 6	12.37	1.41	10.10	19. 7	23.22	21.23	13.45	2.38	8.56	18.47	23.21
17	20.55	12.16	1.17	10.31	19.21	23.24	21.13	13.26	2.14	9.18	19. 2	23.23
18	20.43	11.56	0.54	10.52	19.34	23.26	21. 3	13. 6	1.51	9.40	19.17	23.25
19	20.31	11.34	0.30	11.13	19.47	23.27	20.52	12.47	1.28	10. 1	19.31	23.26
20	20.18	11.13	0.06S.	11.33	20. 0	23.27	20.41	12.27	1. 4	10.23	19.45	23.27
21	20. 6	10.52	0.17N.	11.54	20.12	23.28	20.29	12. 7	0.41	10.45	19.58	23.28
22	19.52	10.30	0.41	12.14	20.24	23.28	20.18	11.47	0.18N.	11. 6	20.11	23.28
23	19.39	10. 8	1. 5	12.34	20.36	23.27	20. 6	11.27	0. 6S.	11.27	20.24	23.27
24	19.25	9.46	1.28	12.54	20.47	23.26	19.53	11. 6	0.29	11.48	20.36	23.26
25	19.10	9.24	1.52	13.13	20.58	23.25	19.40	10.46	0.53	12. 9	20.48	23.25
26	18.56	9. 2	2.15	13.33	21. 9	23.23	19.27	10.25	1.16	12.30	20.59	23.23
27	18.40	8.39	2.39	13.52	21.19	23.21	19.14	10. 4	1.40	12.50	21.10	23.20
28	18.25	8.17	3. 2	14.11	21.29	23.18	19. 0	9.43	2. 3	13.10	21.21	23.18
29	18. 9	7.54	3.26	14.30	21.39	23.15	18.46	9.21	2.26	13.30	21.32	23.14
30	17.53		3.49	14.48	21.48	23.12	18.32	9. 0	2.50	13.50	21.41	23.10
31	17.37		4.12		21.56		18.17	8.38		14.10		23. 6

TABLE XIII.

For reducing the Sun's Declination to any Meridian, and to any Time under that Meridian; containing Proportional Parts of the Daily Difference of the Sun's Declination to every Hour, and to every Fifteen Degrees of Longitude.

	Time.	XIII. H.	XIV. H.	XV. H.	XVI. H.	XVII. H.	XVIII. H.	XIX. H.	XX. H.	XXI. H.	XXII. H.	XXIII. H.	XXIV. H.
	Long.	195°	210°	225°	240°	255°	270°	285°	300°	315°	330°	345°	360°
Daily Difference of Declination in Miles, and to	′	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
	1	0 32.5	0 35.0	0 37.5	0 40.0	0 42.5	0 45.0	0 47.5	0 50.0	0 52.5	0 55.0	0 57.5	1 0.0
	2	1 1.0	1 10.0	1 15.0	1 20.0	1 25.0	1 30.0	1 35.0	1 40.0	1 45.0	1 50.0	1 55.0	2 0.0
	3	1 37.5	1 45.0	2 52.5	2 0.0	2 7.0	2 15.0	2 22.5	2 30.0	2 37.5	2 45.0	2 52.5	3 0.0
	4	2 10.0	2 20.0	2 30.0	2 40.0	2 50.0	3 0.0	3 10.0	3 20.0	3 30.0	3 40.0	3 50.0	4 0.0
	5	2 42.5	2 55.0	3 7.5	3 20.0	3 32.5	3 45.0	3 57.5	4 10.0	4 22.5	4 35.0	4 37.5	5 0.0
	6	3 15.0	3 30.0	3 45.0	4 0.0	4 15.0	4 30.0	4 45.0	5 0.0	5 15.0	5 30 0	5 45.0	6 0.0
	7	3 47.5	4 5.0	4 22.5	4 40.0	4 57.5	5 15.0	5 32.5	5 50.0	6 7.5	6 25.0	6 42.5	7 0.0
	8	4 20.0	4 40.0	5 0.0	5 20.0	5 40.0	6 0.0	6 20.0	6 40.0	7 0.0	7 20.0	7 40.0	8 0.0
	9	4 52.5	5 15.0	5 37.5	6 0.0	6 22.5	6 45.0	7 7.5	7 30.0	7 52.5	8 15.0	8 37.5	9 0.0
	10	5 25.0	5 50.0	6 15.0	6 40.0	7 5.0	7 30.0	7 55.0	8 20.0	8 45.0	9 10.0	9 35.0	10 0.0
	11	5 57.5	6 25.0	6 52.5	7 20.0	7 47.5	8 15.0	8 42.5	9 10.0	9 37.5	10 5.0	10 32.5	11 0.0
	12	6 30.0	7 0.0	7 30.0	8 0.0	8 30 0	9 0.0	9 30.0	10 0.0	10 30.0	11 0.0	11 30.0	12 0.0
	13	7 2.5	7 35.0	8 7.5	8 40.0	9 12.5	9 45.0	10 17.5	10 50.0	11 22.5	11 55.0	12 27.5	13 0.0
	14	7 35.0	8 10.0	8 45.0	9 20.0	9 55.0	10 30.0	11 5.0	11 40.0	12 15.0	12 50.0	13 25.0	14 0.0
	15	8 7.5	8 45.0	9 22.5	10 0.0	10 37.5	11 15.0	11 52.5	12 30.0	13 7.5	13 45.0	14 22.5	15 0.0
	16	8 40.0	9 20.0	10 0.0	10 40.0	11 20.0	12 0.0	12 40.0	13 20.0	14 0.0	14 40.0	15 20.0	16 0.0
	17	9 12.5	9 55.0	10 37.5	11 20.0	12 25.0	12 45.0	13 27.5	14 10.0	14 52.5	15 35.0	16 17.5	17 0.0
	18	9 45.0	10 30.0	11 15.0	12 0.0	12 45.0	13 30.0	14 15.0	15 0.0	15 45.0	16 30.0	17 15.0	18 0.0
	19	10 17.5	11 5.0	11 52.5	12 40.0	13 27.5	14 15.0	15 2.5	15 50.0	16 37.5	17 25 0	18 12.5	19 0.0
	20	10 50.0	11 40.0	12 30.0	13 20.0	14 10.0	15 0.0	15 50.0	16 40.0	17 30.0	18 20.0	19 10 0	20 0.0
	21	11 22.5	12 15.0	13 7.5	14 0.0	14 52.5	15 45.0	16 37.5	17 30.0	18 22.5	19 15.0	20 7.5	21 0.0
	22	11 55.0	12 50.0	13 45.0	14 40.0	15 35.0	16 30.0	17 25.0	18 20.0	19 15 0	20 10.0	21 5.0	22 0.0
	23	12 27.5	13 25.0	14 22.5	15 20.0	16 17.5	17 15.0	18 12.5	19 10.0	20 7.5	21 5.0	22 2.5	23 0.0
	24	13 0 0	14 0.0	15 0.0	16 0.0	17 0.0	18 0.0	19 0.0	20 0.0	21 0.0	22 0.0	23 0.0	24 0.0
every six Seconds.	6	0 3.2	0 3.5	0 3.7	0 4.0	0 4.2	0 4.5	0 4.7	0 5.0	0 5.2	0 5.4	0 5.7	0 6.0
	12	0 6.5	0 7.0	0 7.5	0 8.0	0 8.5	0 9.0	0 9.5	0 10.0	0 10.5	0 11.0	0 11.5	0 12.0
	18	0 9.7	0 10.5	0 11.2	0 12.0	0 12.7	0 13.5	0 14.2	0 15.0	0 15.7	0 16.5	0 17.2	0 18.0
	24	0 13.0	0 14.0	0 15.0	0 16 0	0 17.0	0 18.0	0 19.0	0 20.0	0 21.0	0 22.0	0 23.0	0 24.0
	30	0 16.2	0 17.5	0 18.7	0 20.0	0 21.2	0 22 5	0 23.7	0 25.0	0 26.2	0 27.5	0 28.7	0 30.0
	36	0 19.5	0 21.0	0 22.5	0 24.0	0 25.5	0 27.0	0 28.5	0 30.0	0 31.5	0 33.0	0 34.5	0 36.0
	42	0 22.7	0 24.5	0 26.2	0 28.0	0 29.7	0 31.5	0 33.2	0 35.0	0 36.7	0 38.5	0 40.2	0 42.0
	48	0 26.0	0 28.0	0 30.0	0 32.0	0 34.0	0 36.0	0 38.0	0 40.0	0 42.0	0 44.0	0 46.0	0 48.0
	54	0 29.2	0 31.5	0 33.7	0 36.0	0 38.2	0 40.5	0 42.7	0 45.0	0 47.2	0 49.5	0 51.7	0 54 0

[TABLE XIII.

For reducing the Sun's Declination to any Meridian, and to any Time under that Meridian: Containing Proportional Parts of the daily Difference of the Sun's Declination to every five Minutes in the Hour; and to every Degree, and fifteen Miles of Longitude.

Time.	0 h 5 m	0 h 10 m	0 h 15 m	0 h 20 m	0 h 25 m	0 h 30 m	0 h 35 m	0 h 40 m	0 h 45 m	0 h 50 m	0 h 55 m	1 h 0 m
Long.	1° 15′	2° 30′	3° 4	5° 0′	6° 15′	7° 30′	8° 30′	10° 0′	11° 15′	12° 30′	13° 45′	15° 0′
Daily Difference of Declination in Miles, and to	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	″ ′	′ ″	′ ″
1	0 0.2	0 0.4	0 0.6	0 0.8	0 1.0	0 1.2	0 1.5	0 1.7	0 1.9	0 2.1	0 2.3	0 2.5
2	0 0.4	0 0.8	0 1.2	0 1.7	0 2.1	0 2.5	0 2.9	0 3.3	0 3.7	0 4.2	0 4.6	0 5.0
3	0 0.6	0 1.2	0 1.9	0 2.5	0 3.1	0 3.7	0 4.4	0 5.0	0 5.6	0 6.2	0 6.9	0 7.5
4	0 0.8	0 1.7	0 2.5	0 3.3	0 4.2	0 5.0	0 5.8	0 6.7	0 7.5	0 8.3	0 9.2	0 10.0
5	0 1.0	0 2.0	0 3.0	0 4.0	0 5.0	0 6.0	0 7.0	0 8.0	0 9.0	0 10.0	0 11.0	0 12.0
6	0 1.2	0 2.5	0 3.7	0 5.0	0 6.2	0 7.5	0 8.7	0 10.0	0 11.2	0 12.5	0 13.7	0 15.0
7	0 1.5	0 2.9	0 4.4	0 5.8	0 7.3	0 8.7	0 10.2	0 11.7	0 13.1	0 14.6	0 16.0	0 17.5
8	0 1.7	0 3.3	0 5.0	0 6.7	0 8.3	0 10.0	0 11.7	0 13.3	0 15.0	0 16.7	0 18.3	0 20.0
9	0 1.9	0 3.7	0 5.6	0 7.5	0 9.4	0 11.2	0 13.1	0 15.0	0 16.9	0 18.7	0 20.6	0 22.5
10	0 2.1	0 4.2	0 6.2	0 8.3	0 10.4	0 12.5	0 14.6	0 16.7	0 18.7	0 20.8	0 22.9	0 25.0
11	0 2.3	0 4.6	0 6.9	0 9.2	0 11.5	0 13.7	0 16.0	0 18.3	0 20.6	0 22.9	0 25.2	0 27.5
12	0 2.5	0 5.0	0 7.5	0 10.0	0 12.5	0 15.0	0 17.5	0 20.0	0 22.5	0 25.0	0 27.5	0 30.0
13	0 2.7	0 5.4	0 8.1	0 10.8	0 13.5	0 16.2	0 19.0	0 21.7	0 24.4	0 27.1	0 29.8	0 32.5
14	0 2.9	0 5.8	0 8.7	0 11.7	0 14.6	0 17.5	0 20.4	0 23.3	0 26.2	0 29.2	0 32.1	0 35.0
15	0 3.1	0 6.2	0 9.4	0 12.5	0 15.6	0 18.7	0 21.9	0 25.0	0 28.1	0 31.2	0 34.4	0 37.5
16	0 3.3	0 6.7	0 10.0	0 13.3	0 16.7	0 20.0	0 23.3	0 26.7	0 30.3	0 33.3	0 36.7	0 40.0
17	0 3.5	0 7.1	0 10.6	0 14.2	0 17.7	0 21.2	0 24.8	0 28.3	0 31.9	0 35.4	0 39.0	0 42.5
18	0 3.7	0 7.5	0 11.2	0 15.0	0 18.7	0 22.5	0 26.2	0 30.0	0 33.7	0 37.5	0 41.1	0 45.0
19	0 4.0	0 7.9	0 11.9	0 15.8	0 19.8	0 23.7	0 27.7	0 31.7	0 35.6	0 39.6	0 43.5	0 47.5
20	0 4.2	0 8.3	0 12.5	0 16.7	0 20.8	0 25.0	0 29.2	0 33.3	0 37.5	0 41.7	0 45.8	0 50.0
21	0 4.4	0 8.7	0 13.1	0 17.5	0 21.9	0 26.2	0 30.6	0 35.7	0 39.4	0 43.7	0 48.1	0 52.5
22	0 4.6	0 9.2	0 13.7	0 18.3	0 22.9	0 27.5	0 32.1	0 36.7	0 41.2	0 45.8	0 50.4	0 55.0
23	0 4.8	0 9.6	0 14.4	0 19.2	0 24.0	0 28.7	0 33.5	0 38.3	0 43.1	0 47.9	0 52.7	0 57.5
24	0 5.0	0 10.0	0 15.0	0 20.0	0 25.0	0 30.0	0 35.0	0 40.0	0 45.0	0 50.0	0 58.0	1 0 0
every six Seconds.												
6	0 0.0	0 0.0	0 0.1	0 0.1	0 0.1	0 0.1	0 0.1	0 0.2	0 0.2	0 0.2	0 0.2	0 0.2
12	0 0.0	0 0.1	0 0.1	0 0.2	0 0.2	0 0.2	0 0.3	0 0.3	0 0.4	0 0.4	0 0.5	0 0.5
18	0 0.1	0 0.1	0 0.2	0 0.2	0 0.3	0 0.4	0 0.4	0 0.5	0 0.6	0 0.6	0 0.7	0 0.7
24	0 0.1	0 0.2	0 0.2	0 0.3	0 0.4	0 0.5	0 0.6	0 0.7	0 0.7	0 0.8	0 0.9	0 1.0
30	0 0.1	0 0.2	0 0.3	0 0.4	0 0.5	0 0.6	0 0.7	0 0.8	0 0.9	0 1.0	0 1.1	0 1.2
36	0 0.1	0 0.2	0 0.4	0 0.5	0 0.6	0 0.7	0 0.9	0 1.0	0 1.1	0 1.2	0 1.4	0 1.5
42	0 0.1	0 0.3	0 0.4	0 0.6	0 0.7	0 0.9	0 1.0	0 1.2	0 1.3	0 1.5	0 1.6	0 1.8
48	0 0.2	0 0.3	0 0.5	0 0.7	0 0.8	0 1.0	0 1.2	0 1.3	0 1.5	0 1.7	0 1.8	0 2.0
54	[illegible]	[illegible]	[illegible]	0 0.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

SUN's RIGHT ASCENSION.

Days.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Days.
	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	
1	18 43	20 56	22 49	0 43	2 34	4 37	6 41	8 46	10 42	12 30	14 26	16 30	1
2	18 48	21 00	22 53	0 46	2 38	4 41	6 45	8 49	10 45	12 33	14 30	16 34	2
3	18 52	21 04	22 57	0 50	2 42	4 45	6 49	8 53	10 49	12 37	14 34	16 39	3
4	18 57	21 08	23 00	0 54	2 45	4 49	6 53	8 57	10 53	12 41	14 38	16 43	4
5	19 01	21 12	23 04	0 57	2 49	4 53	6 57	9 01	10 56	12 44	14 42	16 47	5
6	19 05	21 16	23 08	1 01	2 5[illegible]	4 57	7 01	9 05	11 00	12 48	14 46	16 52	6
7	19 10	21 20	23 11	1 05	2 57	5 01	7 06	9 09	11 03	12 52	14 50	16 56	7
8	19 14	21 24	23 15	1 08	3 01	5 05	7 10	9 13	11 07	12 55	14 54	17 00	8
9	19 19	21 28	23 19	1 12	3 05	5 09	7 14	9 16	11 11	12 59	14 58	17 05	9
10	19 23	21 32	23 22	1 15	3 09	5 14	7 18	9 20	11 14	13 03	15 02	17 09	10
11	19 27	21 36	23 26	1 19	3 12	5 18	7 22	9 24	11 18	13 06	15 06	17 14	11
12	19 32	21 40	23 30	1 23	3 16	5 22	7 26	9 28	11 21	13 10	15 10	17 18	12
13	19 36	21 44	23 33	1 26	3 20	5 26	7 30	9 32	11 25	13 14	15 14	17 22	13
14	19 40	21 48	23 37	1 30	3 24	5 30	7 34	9 35	11 29	13 17	15 18	17 27	14
15	19 45	21 52	23 41	1 34	3 28	5 34	7 38	9 39	11 32	13 21	15 22	17 31	15
16	19 49	21 56	23 44	1 38	3 32	5 38	7 42	9 43	11 36	13 25	15 26	17 36	16
17	19 53	22 00	23 48	1 41	3 36	5 43	7 46	9 47	11 39	13 29	15 31	17 40	17
18	19 57	22 04	23 52	1 45	3 40	5 47	7 50	9 50	11 43	13 32	15 35	17 45	18
19	20 02	22 07	23 55	1 49	3 44	5 51	7 54	9 54	11 47	13 36	15 39	17 49	19
20	20 06	22 11	23 59	1 52	3 48	5 55	7 58	9 58	11 50	13 40	15 43	17 54	20
21	20 10	22 15	0 03	1 56	3 52	5 59	8 02	10 01	11 54	13 44	15 47	17 58	21
22	20 14	22 19	0 06	2 00	3 56	6 03	8 06	10 05	11 57	13 47	15 52	18 02	22
23	20 19	22 23	0 10	2 04	4 00	6 08	8 10	10 09	12 01	13 51	15 56	18 07	23
24	20 23	22 27	0 14	2 07	4 04	6 12	8 14	10 12	12 04	13 55	16 00	18 11	24
25	20 27	22 30	0 17	2 11	4 08	6 16	8 18	10 16	12 08	13 59	16 04	18 16	25
26	20 31	22 34	0 21	2 15	4 12	6 20	8 22	10 20	12 12	14 03	16 09	18 20	26
27	20 35	22 38	0 24	2 19	4 16	6 24	8 26	10 23	12 15	14 07	16 13	18 25	27
28	20 40	22 42	0 28	2 22	4 20	6 28	8 30	10 27	12 19	14 10	16 17	18 29	28
29	20 44	22 45	0 32	2 26	4 24	6 33	8 34	10 31	12 23	14 14	16 21	18 34	29
30	20 48		0 35	2 30	4 28	6 37	8 38	10 34	12 26	14 18	16 26	18 38	30
31	20 52		0 39		4 32		8 42	10 38		14 22		18 42	31

This Table is ſufficiently exact for finding when any Star comes to the Meridian, in order to obtain the Latitude; but in all calculations for determining the true Apparent Time, the Sun's Right Aſcenſion muſt be taken out of the Nautical Almanack, as it is there calculated to a greater degree of accuracy. If the Sun's Right Aſcenſion be wanted in Degrees, it is readily found by converting Time into Degrees, by means of Table XVI.

Table XV.

The Right Afcenfions and Declinations of the principal fixed Stars, adapted to the Beginning of the Year 1806.

Names of the Stars.	Right Afcenfion in Time.	Right Afcenfion Ann. Var.	Right Afcenfion in Degrees.	Declination.	An. Var.
	H. M. S.	s.			S.
Algenib	0 3 16	+ 3·06	0° 49′ 0″	14° 50′ 58″ N.	+20·0
Schedar	0 29 41	3·31	7 25 15	55 28 3 —	+19·91
Pole Star	0 53 38	12·89	13 24 30	88 16 10 —	+19·6
Mirach	0 58 54	3·30	14 33 30	34 35 26 —	+19·4
Almaach	1 52 4	3·62	28 1 0	41 23 18 —	+17·80
a ARIETIS	1 56 15	3·34	29 3 45	22 32 24 —	+17·5
Menkar	2 52 9	3·12	43 2 15	3 19 29 —	+14·6
Algol	2 55 36	3·85	43 54 0	40 11 54 —	+14·4
Pleiades	3 35 59	3·55	53 59 45	23 27 32 —	+12·0
Hyades	4 8 47	3·39	62 11 45	15 9 0 —	+ 9·60
ALDEBARAN	4 24 48	3·42	66 12 0	16 6 35 —	+ 8·1
Capella	5 2 23	4·41	75 35 45	45 47 21 —	+ 5·0
Bellatrix	5 14 44	3·21	78 41 0	6 9 47 —	+ 4·0
Betelguefe	5 44 40	3·24	86 10 0	7 21 36 —	+ 1·4
Caftor	7 22 12	3·85	110 33 0	32 17 59 —	— 6·9
Procyon	7 29 8	3·14	112 17 0	5 43 24 —	— 7·5
POLLUX	7 33 25	3·69	113 21 15	28 29 0 —	— 7·9
Acubens	8 47 50	3·24	131 57 45	12 36 5 —	—13·30
REGULUS	9 58 1	3·20	149 30 15	12 54 38 —	—17·2
Lower Pointer	10 50 3	3·71	162 30 45	57 25 9 —	—19·10
Upper Pointer	10 51 39	3·82	162 54 45	62 47 48 —	—19·14
Aliath	12 45 33	2·69	191 23 15	57 1 33 —	—19·69
Benetnach	13 39 53	2·39	204 58 15	50 27 14 —	—18·1
Arcturus	14 6 48	2·72	211 42 0	20 11 50 —	—19·1
Mirach	14 45 36	2·63	221 39 0	27 53 44 —	—15·67
Alphacca	15 26 28	2·53	231 37 0	27 22 34 N.	—12·4
Ras Algathi	17 5 48	2·73	256 27 0	14 37 14 N.	— 4·7
Ras Alagus	17 25 56	2·77	261 29 0	12 42 49 N.	— 3·0
Ruftaben	17 52 7	1·39	268 1 45	51 31 2 N.	— 0·7
Vega	18 30 22	2·03	277 35 30	38 36 25 N.	+ 2·6
ALTAIR	19 41 22	2·92	295 20 30	8 21 39 N.	+ 8·5
Deneb	20 31 49	2·03	308 42 15	44 35 34 N.	+12·5
Alderaimin	21 13 56	1·44	318 29 0	61 46 0 N.	+14·95
Scheat	22 54 23	2·87	343 35 45	27 1 51 N.	+19·2
MARKAB	22 55 7	2·96	343 46 45	14 9 51 N.	+19·2
Achernar	1 30 27	2·25	22 36 45	58 18 32 S.	—18·5
Rigel	5 5 13	2·87	76 18 15	8 26 6 S.	— 4·8
Canopus	6 19 39	1·33	94 54 45	52 35 36 S.	+ 1·7
Syrius	6 36 35	2·65	99 8 45	16 27 30 S.	+ 4·2
Alphard	9 18 2	2·93	139 30 30	7 49 24 S.	+15·2
VIRGIN's SPIKE	13 14 59	3·14	198 44 45	10 8 32 S.	+18·9
Zubenefch	14 40 10	3·29	220 2 30	15 8 24 S.	+15·3
Zubenelg	15 6 36	3·22	226 39 0	8 34 29 S.	+13·8
ANTARES	16 17 31	3·64	244 22 45	25 59 16 S.	+ 8·7
FOMALHAUT	22 46 53	3·33	341 43 15	30 38 44 S.	—18·97

If the places of thefe ftars are wanted for any time before the beginning of the year 1806, multiply the annual variation, both in right afcenfion and declination, by the number of years before 1806, and fubtract the product from the right afcenfion ftanding in the table; but the product of the annual variation in declination muft be added to, or fubtracted from the declination, with a contrary fign; but for any year after 1806, the variation in right afcenfion muft be added to the right afcenfion in this table, and the variation in declination muft either be added to, or fubtracted from it, according as their figns are, to fit the declination to any fucceeding year. The annual variation is fet down for feconds, and decimals of a fecond. The ftars in the preceding table will be found to correfpond with thofe whofe names are marked in the planifpheres; for a further defcription of which, fee p. 214.

TABLE XVI.

For turning Degrees and Minutes into Time, and the contrary

D	H M	D	H M	D	H M	D	H M	D	H M	D	H M	D M	M
												M S	Sec.
M	M S	M	M S	M	M S	M	M S	M	M S	M	M S	S T	Thi.
1	0. 4	61	4. 4	121	8. 4	181	12. 4	241	16. 4	301	20. 4	0 15	1
2	0. 8	62	4. 8	122	8. 8	182	12. 8	242	16. 8	302	20. 8	0 30	2
3	0.12	63	4.12	123	8.12	183	12.12	243	16.12	303	20.12	0 45	3
4	0.16	64	4.16	124	8.16	184	12.16	244	16.16	304	20.16	1 0	4
5	0.20	65	4.20	125	8.20	185	12.20	245	16.20	305	20.20	1 15	5
6	0.24	66	4.24	126	8.24	186	12.24	246	16.24	306	20.24	1 30	6
7	0.28	67	4.28	127	8.28	187	12.28	247	16.28	307	20.28	1 45	7
8	0.32	68	4.32	128	8.32	188	12.32	248	16.32	308	20.32	2 0	8
9	0.36	69	4.36	129	8.36	189	12.36	249	16.36	309	20.36	2 15	9
10	0.40	70	4.40	130	8.40	190	12.40	250	16.40	310	20.40	2 30	10
11	0.44	71	4.44	131	8.44	191	12.44	251	16.44	311	20.44	2 45	11
12	0.48	72	4.48	132	8.48	192	12.48	252	16.48	312	20.48	3 0	12
13	0.52	73	4.52	133	8.52	193	12.52	253	16.52	313	20.52	3 15	13
14	0.56	74	4.56	134	8.56	194	12.56	254	16.56	314	20.56	3 30	14
15	1. 0	75	5. 0	135	9. 0	195	13. 0	255	17. 0	315	21. 0	3 45	15
16	1. 4	76	5. 4	136	9. 4	196	13. 4	256	17. 4	316	21. 4	4 0	16
17	1. 8	77	5. 8	137	9. 8	197	13. 8	257	17. 8	317	21. 8	4 15	17
18	1.12	78	5.12	138	9.12	198	13.12	258	17.12	318	21.12	4 30	18
19	1.16	79	5.16	139	9.16	199	13.16	259	17.16	319	21.16	4 45	19
20	1.20	80	5.20	140	9.20	200	13.20	260	17.20	320	21.20	5 0	20
21	1.24	81	5.24	141	9.24	201	13.24	261	17.24	321	21.24	5 15	21
22	1.28	82	5.28	142	9.28	202	13.28	262	17.28	322	21.28	5 30	22
23	1.32	83	5.32	143	9.32	203	13.32	263	17.32	323	21.32	5 45	23
24	1.36	84	5.36	144	9.36	204	13.36	264	17.36	324	21.36	6 0	24
25	1.40	85	5.40	145	9.40	205	13.40	265	17.40	325	21.40	6 15	25
26	1.44	86	5.44	146	9.44	206	13.44	266	17.44	326	21.44	6 30	26
27	1.48	87	5.48	147	9.48	207	13.48	267	17.48	327	21.48	6 45	27
28	1.52	88	5.52	148	9.52	208	13.52	268	17.52	328	21.52	7 0	28
29	1.56	89	5.56	149	9.56	209	13.56	269	17.56	329	21.56	7 15	29
30	2. 0	90	6. 0	150	10. 0	210	14. 0	270	18. 0	330	22. 0	7 30	30
31	2. 4	91	6. 4	151	10. 4	211	14. 4	271	18. 4	331	22. 4	7 45	31
32	2. 8	92	6. 8	152	10. 8	212	14. 8	272	18. 8	332	22. 8	8 0	32
33	2.12	93	6.12	153	10.12	213	14.12	273	18.12	333	22.12	8 15	33
34	2.16	94	6.16	154	10.16	214	14.16	274	18.16	334	22.16	8 30	34
35	2.20	95	6.20	155	10.20	215	14.20	275	18.20	335	22.20	8 45	35
36	2.24	96	6.24	156	10.24	216	14.24	276	18.24	336	22.24	9 0	36
37	2.28	97	6.28	157	10.28	217	14.28	277	18.28	337	22.28	9 15	37
38	2.32	98	6.32	158	10.32	218	14.32	278	18.32	338	22.32	9 30	38
39	2.36	99	6.36	159	10.36	219	14.36	279	18.36	339	22.36	9 45	39
40	2.40	100	6.40	160	10.40	220	14.40	280	18.40	340	22.40	10 0	40
41	2.44	101	6.44	161	10.44	221	14.44	281	18.44	341	22.44	10 15	41
42	2.48	102	6.48	162	10.48	222	14.48	282	18.48	342	22.48	10 30	42
43	2.52	103	6.52	163	10.52	223	14.52	283	18.52	343	22.52	10 45	43
44	2.56	104	6.56	164	10.56	224	14.56	284	18.56	344	22.56	11 0	44
45	3. 0	105	7. 0	165	11. 0	225	15. 0	285	19. 0	345	23. 0	11 15	45
46	3. 4	106	7. 4	166	11. 4	226	15. 4	286	19. 4	346	23. 4	11 30	46
47	3. 8	107	7. 8	167	11. 8	227	15. 8	287	19. 8	347	23. 8	11 45	47
48	3.12	108	7.12	168	11.12	228	15.12	288	19.12	348	23.12	12 0	48
49	3.16	109	7.16	169	11.16	229	15.16	289	19.16	349	23.16	12 15	49
50	3.20	110	7.20	170	11.20	230	15.20	290	19.20	350	23.20	12 30	50
51	3.24	111	7.24	171	11.24	231	15.24	291	19.24	351	23.24	12 45	51
52	3.28	112	7.28	172	11.28	232	15.28	292	19.28	352	23.28	13 0	52
53	3.32	113	7.32	173	11.32	233	15.32	293	19.32	353	23.32	13 15	53
54	3.36	114	7.36	174	11.36	234	15.36	294	19.36	354	23.36	13 30	54
55	3.40	115	7.40	175	11.40	235	15.40	295	19.40	355	23.40	13 45	55
56	3.44	116	7.44	176	11.44	236	15.44	296	19.44	356	23.44	14 0	56
57	3.48	117	7.48	177	11.48	237	15.48	297	19.48	357	23.48	14 15	57
58	3.52	118	7.52	178	11.52	238	15.52	298	19.52	358	23.52	14 30	58
59	3.56	119	7.56	179	11.56	239	15.56	299	19.56	359	23.56	14 45	59
60	4. 0	120	8. 0	180	12. 0	240	16. 0	300	20. 0	360	24. 0	15 0	60

Table XV.

The Right Afcenfions and Declinations of the principal fixed Stars, adapted to the Beginning of the Year 1806.

Names of the Stars.	Right Afcenfion in Time. H. M. S.	Right Afcenfion Ann. Var. S.	Right Afcenfion in Degrees.	Declination.	An. Var. S.
Algenib	0 3 16	+ 3·06	0° 49′ 0″	14° 50′ 58″ N.	+20· 0
Schedar	0 29 41	3·31	7 25 15	55 28 3 —	+19·91
Pole Star	0 53 38	12·89	13 24 30	88 16 10 —	+19 6
Mirach	0 58 54	3·30	14 33 30	34 35 26 —	+19 4
Almaach	1 52 4	3·62	28 1 0	41 23 18 —	+17·80
α ARIETIS	1 56 15	3·34	29 3 45	22 32 24 —	+17 5
Menkar	2 52 9	3·12	43 2 15	3 19 29 —	+14· 6
Algol	2 55 36	3 85	43 54 0	40 11 54 —	+14· 4
Pleiades	3 35 59	3·55	53 59 45	23 27 32 —	+12 0
Hyades	4 8 47	3·39	62 11 45	15 9 0 —	+ 9 60
ALDEBARAN	4 24 48	3·42	66 12 0	16 6 35 —	+ 8· 1
Capella	5 2 23	4·41	75 35 45	45 47 21 —	+ 5 0
Bellatrix.	5 14 44	3·21	78 41 0	6 9 47 —	+ 4 0
Betelguefe	5 44 40	3·24	86 10 0	7 21 36 —	+ 1· 4
Caftor	7 22 12	3·85	110 33 0	32 17 59 —	— 6 9
Procyon.	7 29 8	3·14	112 17 0	5 43 24 —	— 7· 5
POLLUX	7 33 25	3 69	113 21 15	28 29 0 —	— 7· 9
Acubens	8 47 50	3·24	131 57 45	12 36 5 —	—13·30
REGULUS	9 58 1	3·20	149 30 15	12 54 38 —	—17· 2
Lower Pointer	10 50 3	3·71	162 30 45	57 25 9 —	—19·10
Upper Pointer	10 51 39	3·82	162 54 45	62 47 48 —	—19·14
Aliath	12 45 33	2·69	191 23 15	57 1 33 —	—19 69
Benetnach	13 39 53	2·39	204 58 15	50 27 14 —	—18· 1
Arcturus	14 6 48	2·72	211 42 0	20 11 50 —	—19 1
Mirach	14 45 36	2 63	221 39 0	27 53 44 —	—15·67
Alphacca	15 26 28	2 53	231 37 0	27 22 34 N.	—12 4
Ras Algathi	17 5 48	2 73	256 27 0	14 37 14 N.	— 4 7
Ras Alagus	17 25 56	2 77	261 29 0	12 42 49 N.	— 3· 0
Ruftaben	17 52 7	1·39	268 1 45	51 31 2 N.	— 0· 7
Vega	18 30 22	2·03	277 35 30	38 36 25 N.	+ 2· 6
ALTAIR	19 41 22	2 92	295 20 30	8 21 39 N.	+ 8· 5
Deneb	20 31 49	2 03	308 42 15	44 35 34 N.	+12 5
Alderaimin	21 13 56	1 44	318 29 0	61 46 0 N.	+14·95
Scheat	22 54 23	2·87	343 35 45	27 1 51 N.	+19· 2
MARKAB	22 55 7	2·96	343 46 45	14 9 51 N.	+19· 2
Achernar	1 30 27	2·25	22 36 45	58 18 32 S.	—18· 5
Rigel	5 5 13	2 87	76 18 15	8 26 6 S	— 4· 8
Canopus	6 19 39	1 33	94 54 45	52 35 36 S.	+ 1· 7
Syrius.	6 36 35	2·65	99 8 45	16 27 30 S	+ 4· 3
Alphard	9 18 2	2·93	139 30 30	7 49 24 S.	+15· 2
VIRGIN's SPIKE	13 14 59	3·14	198 44 45	10 8 32 S	+18· 9
Zubenefch	14 40 10	3 29	220 2 30	15 8 24 S.	+15· 3
Zubenelg	15 6 36	3 22	226 39 0	8 34 29 S.	+13· 8
ANTARES	16 17 31	3·64	244 22 45	25 59 16 S.	+ 8· 7
FOMALHAUT	22 46 53	3·33	341 43 15	30 38 44 S	—18 97

If the places of thefe ftars are wanted for any time before the beginning of the year 1806, multiply the annual variation, both in right afcenfion and declination, by the number of years before 1806, and fubtract the product from the right afcenfion ftanding in the table; but the product of the annual variation in declination muft be added to, or fubtracted from the declination, with a contrary fign; but for any year after 1806, the variation in right afcenfion muft be added to the right afcenfion in this table, and the variation in declination muft either be added to, or fubtracted from it, according as their figns are, to fit the declination to any fucceeding year. The annual variation is fet down for feconds, and decimals of a fecond. The ftars in the preceding table will be found to correfpond with thofe whofe names are marked in the planifpheres; for a further defcription of which, fee p. 214.

TABLE XVI.

For turning Degrees and Minutes into Time, and the contrary | D M M

D M	H M M S	D M	H M M S	D M	H M M S	D M	H M M S	D M	H M M S	D M	H M M S	M S S T	Sec. Thi.
1	0. 4	61	4. 4	121	8. 4	181	12. 4	241	16. 4	301	20. 4	0 15	1
2	0. 8	62	4. 8	122	8. 8	182	12. 8	242	16. 8	302	20. 8	0 30	2
3	0.12	63	4.12	123	8.12	183	12.12	243	16.12	303	20.12	0 45	3
4	0.16	64	4.16	124	8.16	184	12.16	244	16.16	304	20.16	1 0	4
5	0.20	65	4.20	125	8.20	185	12.20	245	16.20	305	20.20	1 15	5
6	0.24	66	4.24	126	8.24	186	12.24	246	16.24	306	20.24	1 30	6
7	0.28	67	4.28	127	8.28	187	12.28	247	16.28	307	20.28	1 45	7
8	0.32	68	4.32	128	8.32	188	12.32	248	16.32	308	20.32	2 0	8
9	0.36	69	4.36	129	8.36	189	12.36	249	16.36	309	20.36	2 15	9
10	0.40	70	4.40	130	8.40	190	12.40	250	16.40	310	20.40	2 30	10
11	0.44	71	4.44	131	8.44	191	12.44	251	16.44	311	20.44	2 45	11
12	0.48	72	4.48	132	8.48	192	12.48	252	16.48	312	20.48	3 0	12
13	0.52	73	4.52	133	8.52	193	12.52	253	16.52	313	20.52	3 15	13
14	0.56	74	4.56	134	8.56	194	12.56	254	16.56	314	20.56	3 30	14
15	1. 0	75	5. 0	135	9. 0	195	13. 0	255	17. 0	315	21. 0	3 45	15
16	1. 4	76	5. 4	136	9. 4	196	13. 4	256	17. 4	316	21. 4	4 0	16
17	1. 8	77	5. 8	137	9. 8	197	13. 8	257	17. 8	317	21. 8	4 15	17
18	1.12	78	5.12	138	9.12	198	13.12	258	17.12	318	21.12	4 30	18
19	1.16	79	5.16	139	9.16	199	13.16	259	17.16	319	21.16	4 45	19
20	1.20	80	5.20	140	9.20	200	13.20	260	17.20	320	21.20	5 0	20
21	1.24	81	5.24	141	9.24	201	13.24	261	17.24	321	21.24	5 15	21
22	1.28	82	5.28	142	9.28	202	13.28	262	17.28	322	21.28	5 30	22
23	1.32	83	5.32	143	9.32	203	13.32	263	17.32	323	21.32	5 45	23
24	1.36	84	5.36	144	9.36	204	13.36	264	17.36	324	21.36	6 0	24
25	1.40	85	5.40	145	9.40	205	13.40	265	17.40	325	21.40	6 15	25
26	1.44	86	5.44	146	9.44	206	13.44	266	17.44	326	21.44	6 30	26
27	1.48	87	5.48	147	9.48	207	13.48	267	17.48	327	21.48	6 45	27
28	1.52	88	5.52	148	9.52	208	13.52	268	17.52	328	21.52	7 0	28
29	1.56	89	5.56	149	9.56	209	13.56	269	17.56	329	21.56	7 15	29
30	2. 0	90	6. 0	150	10. 0	210	14. 0	270	18. 0	330	22. 0	7 30	30
31	2. 4	91	6. 4	151	10. 4	211	14. 4	271	18. 4	331	22. 4	7 45	31
32	2. 8	92	6. 8	152	10. 8	212	14. 8	272	18. 8	332	22. 8	8 0	32
33	2.12	93	6.12	153	10.12	213	14.12	273	18.12	333	22.12	8 15	33
34	2.16	94	6.16	154	10.16	214	14.16	274	18.16	334	22.16	8 30	34
35	2.20	95	6.20	155	10.20	215	14.20	275	18.20	335	22.20	8 45	35
36	2.24	96	6.24	156	10.24	216	14.24	276	18.24	336	22.24	9 0	36
37	2.28	97	6.28	157	10.28	217	14.28	277	18.28	337	22.28	9 15	37
38	2.32	98	6.32	158	10.32	218	14.32	278	18.32	338	22.32	9 30	38
39	2.36	99	6.36	159	10.36	219	14.36	279	18.36	339	22.36	9 45	39
40	2.40	100	6.40	160	10.40	220	14.40	280	18.40	340	22.40	10 0	40
41	2.44	101	6.44	161	10.44	221	14.44	281	18.44	341	22.44	10 15	41
42	2.48	102	6.48	162	10.48	222	14.48	282	18.48	342	22.48	10 30	42
43	2.52	103	6.52	163	10.52	223	14.52	283	18.52	343	22.52	10 45	43
44	2.56	104	6.56	164	10.56	224	14.56	284	18.56	344	22.56	11 0	44
45	3. 0	105	7. 0	165	11. 0	225	15. 0	285	19. 0	345	23. 0	11 15	45
46	3. 4	106	7. 4	166	11. 4	226	15. 4	286	19. 4	346	23. 4	11 30	46
47	3. 8	107	7. 8	167	11. 8	227	15. 8	287	19. 8	347	23. 8	11 45	47
48	3.12	108	7.12	168	11.12	228	15.12	288	19.12	348	23.12	12 0	48
49	3.16	109	7.16	169	11.16	229	15.16	289	19.16	349	23.16	12 15	49
50	3.20	110	7.20	170	11.20	230	15.20	290	19.20	350	23.20	12 30	50
51	3.24	111	7.24	171	11.24	231	15.24	291	19.24	351	23.24	12 45	51
52	3.28	112	7.28	172	11.28	232	15.28	292	19.28	352	23.28	13 0	52
53	3.32	113	7.32	173	11.32	233	15.32	293	19.32	353	23.32	13 15	53
54	3.36	114	7.36	174	11.36	234	15.36	294	19.36	354	23.36	13 30	54
55	3.40	115	7.40	175	11.40	235	15.40	295	19.40	355	23.40	13 45	55
56	3.44	116	7.44	176	11.44	236	15.44	296	19.44	356	23.44	14 0	56
57	3.48	117	7.48	177	11.48	237	15.48	297	19.48	357	23.48	14 15	57
58	3.52	118	7.52	178	11.52	238	15.52	298	19.52	358	23.52	14 30	58
59	3.56	119	7.56	179	11.56	239	15.56	299	19.56	359	23.56	14 45	59
60	4. 0	120	8. 0	180	12. 0	240	16. 0	300	20. 0	360	24. 0	15 0	60

TABLE XVII.

To reduce the time of the Moon's Paſſage over the Meridian of Greenwich to the Time of its Paſſage over any other Meridian,

Ship's Long.	Daily Variation of the Moon's paſſing the Meridian.														Time from ☽ Southing
	40'	42'	44'	46'	48'	50'	52'	54'	56'	58'	60'	62'	64'	66'	
°	m	m	m	m	m	m	m	m	m	m	m	m	m	m	H. M.
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 0
5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0 20
10	1	1	1	1	1	1	1	1	1	2	2	2	2	2	0 40
15	2	2	2	2	2	2	2	2	2	2	2	3	3	3	1 0
20	2	2	2	2	3	3	3	3	3	3	3	3	4	4	1 20
25	3	3	3	3	3	3	4	4	4	4	4	4	4	5	1 40
30	3	3	4	4	4	4	4	4	5	5	5	5	5	5	2 0
35	4	4	4	5	5	5	5	5	5	6	6	6	6	6	2 20
40	4	5	5	5	5	6	6	6	6	6	7	7	7	7	2 40
45	5	5	6	6	6	6	6	7	7	7	7	8	8	8	3 0
50	6	6	6	6	7	7	7	7	8	8	8	9	9	9	3 20
55	6	6	7	7	8	8	8	8	9	9	9	9	10	10	3 40
60	7	7	8	8	8	8	9	9	9	10	10	10	11	11	4 0
65	7	8	8	8	9	9	9	10	10	10	11	11	12	12	4 20
70	8	8	9	9	9	10	10	10	11	11	12	12	12	13	4 40
75	8	9	9	10	10	10	11	11	12	12	12	13	13	14	5 0
80	9	9	10	10	11	11	12	12	12	13	13	14	14	15	5 20
85	9	10	10	11	11	12	12	13	13	14	14	15	15	16	5 40
90	10	10	11	11	12	12	13	13	14	14	15	15	16	16	6 0
95	11	11	12	12	13	13	14	14	15	15	16	16	17	17	6 20
100	11	12	12	13	13	14	14	15	16	16	17	17	18	18	6 40
105	12	12	13	13	14	15	15	16	16	17	17	18	19	19	7 0
110	12	13	13	14	15	15	16	16	17	18	18	19	20	20	7 20
115	13	13	14	15	15	16	17	17	18	19	19	20	20	21	7 40
120	13	14	15	15	16	17	17	18	19	19	20	21	21	22	8 0
125	14	15	15	16	17	17	18	19	19	20	21	21	22	23	8 20
130	14	15	16	17	17	18	19	19	20	21	22	22	23	24	8 40
135	15	16	16	17	18	19	19	20	21	22	22	23	24	25	9 0
140	16	16	17	18	19	19	20	21	22	23	23	24	25	26	9 20
145	16	17	18	19	19	20	21	22	23	23	24	25	26	27	9 40
150	17	17	18	19	20	21	22	22	23	24	25	26	27	27	10 0
155	17	18	19	20	21	22	22	23	24	25	26	27	28	28	10 20
160	18	19	20	20	21	22	23	24	25	26	27	28	28	29	10 40
165	18	19	20	21	22	23	24	25	26	27	27	28	29	30	11 0
170	19	20	21	22	23	24	25	25	26	27	28	29	30	31	11 20
175	19	20	21	22	23	24	25	26	27	28	29	30	31	32	11 40
180	20	21	22	23	24	25	26	27	28	29	30	31	32	33	12 0
	40'	42'	44'	46'	48'	50'	52'	54'	56'	58'	60'	62'	64'	66'	

Table XVIII contains the decimals to every minute in twelve hours, and is uſeful to find the proportion of time in twelve hours, by multiplying it by the number found under the top hours in the column, and oppoſite to the minute in the left hand ſide column; from the product cut off four figures from the right hand, the remainder is the proportion of time required, if there is no fraction.

Example. If the difference in 12 hours is 6 minutes, what will it be in 6 hours?

Decimal of 6 hours is = ,5000
× by 6 minutes 6
Anſwer 3 minutes ——— 3,0000

If the difference is for a proportion of time in 24 hours, multiply the difference by the decimal of half the time required; from the poduct cut off four figures from the right, the figures to the left is the anſwer.

Decimals to every Minute in Twelve Hours.

	0	1	2	3	4	5	6	7	8	9	10	11
0		.0833	.1667	.2500	.3333	.4167	.5000	.5833	.6667	.7500	.8333	.9167
1	.0013	.0846	.1680	.2513	.3346	.4180	.5013	.5846	.6680	.7513	.8346	.9180
2	.0028	.0861	.1695	.2528	.3361	.4195	.5028	.5861	.6695	.7525	.8361	.9195
3	.0042	.0875	.1709	.2542	.3375	.4209	.5042	.5875	.6709	.7542	.8375	.9206
4	.0055	.0888	.1722	.2555	.3383	.4222	.5055	.5888	.6722	.7555	.8383	.9222
5	.0069	.0902	.1736	.2569	.3402	.4236	.5069	.5902	.6736	.7569	.8402	.9236
6	.0083	.0916	.1750	.2583	.3416	.4250	.5083	.5916	.6750	.7583	.8416	.9250
7	.0097	.0930	.1764	.2597	.3430	.4264	.5097	.5930	.6764	.7597	.8430	.9264
8	.0111	.0944	.1778	.2611	.3444	.4278	.5111	.5944	.6778	.7611	.8444	.9278
9	.0125	.0958	.1792	.2625	.3458	.4292	.5125	.5958	.6792	.7625	.8458	.9292
10	.0139	.0972	.1806	.2639	.3472	.4306	.5139	.5972	.6806	.7639	.8472	.9306
11	.0152	.0985	.1819	.2652	.3485	.4319	.5151	.5985	.6819	.7652	.8485	.9319
12	.0167	.1000	.1834	.2667	.3500	.4334	.5167	.6000	.6834	.7667	.8500	.9334
13	.0181	.1014	.1848	.2681	.3514	.4348	.5181	.6014	.6848	.7681	.8514	.9348
14	.0194	.1027	.1861	.2694	.3527	.4361	.5194	.6027	.6861	.7694	.8527	.9361
15	.0208	.1041	.1875	.2708	.3541	.4375	.5208	.6041	.6875	.7708	.8541	.9375
16	.0222	.1055	.1889	.2722	.3555	.4389	.5222	.6055	.6889	.7722	.8555	.9389
17	.0236	.1069	.1903	.2730	.3569	.4403	.5236	.6069	.6903	.7736	.8569	.9403
18	.0250	.1083	.1917	.2750	.3583	.4417	.5250	.6083	.6917	.7750	.8583	.9417
19	.0264	.1097	.1931	.2764	.3597	.4431	.5264	.6097	.6931	.7764	.8597	.9431
20	.0278	.1111	.1945	.2778	.3611	.4445	.5278	.6111	.6945	.7778	.8611	.9445
21	.0292	.1125	.1959	.2792	.3625	.4459	.5292	.6125	.6959	.7792	.8625	.9459
22	.0306	.1139	.1973	.2806	.3639	.4473	.5306	.6139	.6973	.7806	.8639	.9473
23	.0319	.1152	.1986	.2819	.3652	.4486	.5319	.6152	.6986	.7819	.8652	.9486
24	.0333	.1166	.2000	.2833	.3666	.4500	.5333	.6166	.7000	.7833	.8666	.9500
25	.0347	.1180	.2014	.2847	.3680	.4514	.5347	.6180	.7014	.7847	.8680	.9514
26	.0361	.1194	.2028	.2861	.3694	.4528	.5361	.6194	.7028	.7861	.6694	.9528
27	.0375	.1208	.2042	.2875	.3708	.4542	.5375	.6208	.7042	.7875	.8708	.9542
28	.0389	.1222	.2056	.2889	.3722	.4556	.5389	.6222	.7056	.7889	.8722	.9556
29	.0403	.1236	.2070	.2903	.3736	.4570	.5403	.6236	.7070	.7903	.8746	.9570
30	.0417	.1250	.2084	.2917	.3750	.4584	.5417	.6250	.7084	.7917	.8750	.9584
31	.0431	.1264	.2098	.2931	.3764	.4598	.5431	.6264	.7098	.7931	.8764	.9598
32	.0444	.1277	.2111	.2944	.3777	.4611	.5444	.6277	.7111	.7944	.8777	.9611
33	.0458	.1291	.2125	.2958	.3791	.4625	.5458	.6291	.7125	.7958	.8791	.9625
34	.0472	.1305	.2139	.2972	.3805	.4639	.5472	.6305	.7139	.7972	.8805	.9639
35	.0486	.1319	.2153	.2986	.3819	.4653	.5486	.6319	.7153	.7986	.8819	.9653
36	.0500	.1333	.2167	.3000	.3833	.4667	.5500	.6333	.7167	.8000	.8833	.9667
37	.0514	.1347	.2181	.3014	.3847	.4681	.5514	.6347	.7181	.8014	.8847	.9681
38	.0528	.1361	.2195	.3028	.3861	.4695	.5528	.6361	.7195	.8028	.8861	.9695
39	.0542	.1375	.2209	.3042	.3875	.4709	.5542	.6375	.7209	.8042	.8875	.9709
40	.0556	.1389	.2223	.3056	.3889	.4723	.5556	.6389	.7223	.8056	.8889	.9723
41	.0569	.1402	.2236	.3069	.3902	.4736	.5569	.6402	.7236	.8069	.8902	.9736
42	.0583	.1416	.2250	.3083	.3916	.4750	.5583	.6416	.7250	.8083	.8916	.9750
43	.0597	.1430	.2264	.3097	.3930	.4764	.5597	.6430	.7264	.8097	.8930	.9764
44	.0611	.1444	.2278	.3111	.3944	.4778	.5611	.6444	.7278	.8111	.8944	.9778
45	.0625	.1458	.2292	.3125	.3958	.4792	.5625	.6458	.7292	.8125	.8958	.9792
46	.0639	.1472	.2306	.3139	.3972	.4806	.5639	.6472	.7306	.8139	.8972	.9806
47	.0653	.1486	.2320	.3153	.3986	.4820	.5653	.6486	.7320	.8153	.8986	.9820
48	.0667	.1500	.2334	.3167	.4000	.4831	.5667	.6500	.7334	.8167	.9000	.9834
49	.0681	.1514	.2348	.3181	.4014	.4848	.5681	.6514	.7348	.8181	.9014	.9848
50	.0694	.1527	.2361	.3194	.4027	.4861	.5694	.6527	.7361	.8194	.9027	.9861
51	.0708	.1541	.2375	.3208	.4041	.4875	.5708	.6541	.7375	.8208	.9041	.9875
52	.0722	.1555	.2389	.3222	.4055	.4889	.5722	.6555	.7389	.8222	.9055	.9889
53	.0736	.1569	.2403	.3236	.4069	.4903	.5736	.6569	.7403	.8236	.9069	.9903
54	.0750	.1583	.2417	.3250	.4083	.4917	.5750	.6583	.7417	.8250	.9083	.9917
55	.0764	.1597	.2431	.3264	.4097	.4931	.5764	.6597	.7431	.8264	.9097	.9931
56	.0778	.1611	.2445	.3278	.4111	.4945	.5778	.6611	.7445	.8278	.9111	.9945
57	.0892	.1625	.2459	.3392	.4125	.4959	.5792	.6625	.7459	.8292	.9125	.9959
58	.0806	.1639	.2473	.3306	.4139	.4973	.5806	.6639	.7473	.8306	.9139	.9973
59	.0819	.1652	.2486	.3319	.4151	.4986	.5819	.6652	.7486	.8319	.9152	.9986

TABLE XIX. AMPLITUDES.

DECLINATION IN DEGREES.

Lat.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	23.28	Lat.
	D.M	D.M	D.M	D.M	DM.	D.M	D.M	D.M	D. M.	D.M	D.M.	D. M.	D.M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M	D. M	D. M.	
1°	1. 0	2. 0	3. 0	4. 0	5. 0	6. 0	7. 0	8. 0	9. 0	10. 0	11. 0	12. 0	13. 0	14. 0	15. 0	16. 0	17. 0	18. 0	19. 0	20. 0	21. 0	22. 0	23. 0	23.28	1°
2	1. 0	2. 0	3. 0	4. 0	5. 0	6. 0	7. 0	8. 0	9. 0	10. 0	11. 0	12. 0	13. 0	14. 1	15. 1	16. 1	17. 1	18. 1	19. 1	20. 1	21. 1	22. 1	23. 1	23.29	2
3	1. 0	2. 0	3. 0	4. 0	5. 0	6. 0	7. 1	8. 1	9. 1	10. 1	11. 1	12. 1	13. 1	14. 1	15. 1	16. 1	17. 1	18. 2	19. 2	20. 2	21. 2	22. 2	23. 2	23.30	3
4	1. 0	2. 0	3. 0	4. 1	5. 1	6. 1	7. 1	8. 1	9. 1	10. 1	11. 2	12. 2	13. 2	14. 2	15. 2	16. 2	17. 3	18. 3	19. 3	20. 3	21. 3	22. 3	23. 4	23.32	4
5	1. 0	2. 0	3. 1	4. 1	5. 1	6. 1	7. 2	8. 2	9. 2	10. 2	11. 3	12. 3	13. 3	14. 3	15. 4	16. 4	17. 4	18. 4	19. 5	20. 5	21. 5	22. 5	23. 6	23.34	5
6	1. 0	2. 0	3. 1	4. 1	5. 2	6. 2	7. 2	8. 3	9. 3	10. 3	11. 4	12. 4	13. 4	14. 5	15. 5	16. 5	17. 6	18. 6	19. 7	20. 7	21. 7	22. 8	23. 8	23.36	6
7	1. 0	2. 1	3. 1	4. 2	5. 2	6. 3	7. 3	8. 4	9. 4	10. 5	11. 5	12. 5	13. 6	14. 6	15. 7	16. 7	17. 8	18. 8	19. 9	20. 9	21.10	22.10	23.11	23.39	7
8	1. 1	2. 1	3. 2	4. 2	5. 3	6. 4	7. 4	8. 5	9. 5	10. 6	11. 7	12. 7	13. 8	14. 8	15. 9	16.10	17.10	18.11	19.12	20.12	21.13	22.14	23.14	23.43	8
9	1. 1	2. 1	3. 2	4. 3	5. 4	6. 5	7. 5	8. 6	9. 7	10. 8	11. 8	12. 9	13.10	14.11	15.11	16.12	17.13	18.14	19.15	20.16	21.16	22.17	23.18	23.47	9
10	1. 1	2. 2	3. 3	4. 4	5. 5	6. 6	7. 7	8. 7	9. 8	10. 9	11.10	12.11	13.12	14.13	15.14	16.15	17.16	18.17	19.18	20.19	21.20	22.21	23.23	23.51	10
11	1. 1	2. 2	3. 3	4. 4	5. 6	6. 7	7. 8	8. 9	9.10	10.11	11.13	12.14	13.15	14.16	15.17	16.18	17.20	18.21	19.22	20.23	21.25	22.26	23.27	23.56	11
12	1. 1	2. 3	3. 4	4. 5	5. 7	6. 8	7. 9	8.11	9.12	10.14	11.15	12.16	13.18	14.19	15.21	16.22	17.24	18.25	19.26	20.28	21.30	22.31	23.33	24. 1	12
13	1. 2	2. 3	3. 5	4. 6	5. 8	6.10	7.11	8.13	9.14	10.16	11.18	12.19	13.21	14.22	15.24	16.26	17.28	18.29	19.31	20.33	21.35	22.37	23.38	24. 7	13
14	1. 2	2. 4	3. 6	4. 7	5. 9	6.11	7.13	8.15	9.17	10.19	11.20	12.22	13.24	14.26	15.28	16.30	17.32	18.34	19.36	20.38	21.40	22.43	23.45	24.14	14
15	2	2. 4	3. 6	4. 8	5.11	6.13	7.15	8.17	9.19	10.21	11.24	12.26	13.28	14.30	15.33	16.35	17.37	18.39	19.42	20.44	21.47	22.49	23.52	24.21	15
16	1. 2	2. 5	3. 7	4.10	5.12	6.15	7.17	8.59	9.22	10.24	11.27	12.29	13.32	14.35	15.37	16.40	17.42	18.45	19.48	20.51	21.53	22.56	23.59	24.28	16
17	1. 3	2. 5	3. 8	4.11	5.14	6.17	7.19	8.22	9.25	10.28	11.31	12.33	13.36	14.39	15.42	16.45	17.48	18.51	19.54	20.57	22. 1	23. 4	24. 7	24.36	17
18	1. 3	2. 6	3. 9	4.12	5.15	6.19	7.22	8.25	9.28	10.31	11.34	12.38	13.41	14.44	15.47	16.51	17.54	18.58	20. 1	21. 5	22. 8	23.12	24.15	24.45	18
19	1. 3	2. 7	3.10	4.14	5.17	6.21	7.24	8.28	9.31	10.35	11.39	12.42	13.46	14.49	15.53	16.57	18. 1	19. 5	20. 8	21.12	22.16	23.20	24.25	24.54	19
20	1. 4	2. 8	3.12	4.15	5.19	6.23	7.27	8.31	9.35	10.39	11.43	12.47	13.51	15.55	15.59	17. 3	18. 8	19.12	20.16	21.21	22.25	23.30	24.34	25. 4	20
21	1. 4	2. 9	3.13	4.17	5.21	6.26	7.30	8.34	9.39	10.43	11.48	12.52	13.57	15. 1	16. 6	17.12	18.15	19.20	20.25	21.29	22.34	23.39	24.45	25.15	21
22	1. 5	2. 9	3.14	4.19	5.24	6.28	7.33	8.38	9.43	10.48	11.53	12.57	14. 2	15. 7	16.13	17.18	18.23	19.28	20.33	21.39	22.44	23.50	24.55	25.26	22
23	1. 5	2.10	3.16	4.21	5.26	6.31	7.36	8.42	9.47	10.52	11.58	13. 3	14. 9	15.14	16.20	17.25	18.31	19.37	20.43	21.49	22.55	24. 1	25. 7	25.38	23
24	1. 6	2.11	3.17	4.23	5.28	6.34	7.40	8.46	9.52	10.57	12. 3	13. 9	14.15	15.21	16.27	17.34	18.40	19.46	20.53	21.59	23. 6	24.13	25.19	25.51	24
25	1. 6	2.12	3.19	4.25	5.31	6.37	7.44	8.50	9.56	11. 3	12. 9	13.16	14.22	15.29	16.36	17.42	18.49	19.56	21. 3	22.10	23.18	24.25	25.32	26. 4	25
26	1. 7	2.14	3.20	4.27	5.34	6.41	7.48	8.54	10. 1	11. 8	12.15	13.22	14.30	15.37	16.44	17.52	18.59	20. 7	21.14	22.22	23.30	24.38	25.46	26.18	26
27	1. 7	2.15	3.22	4.29	5.37	6. 4	7.52	8.5	10. 7	11.14	12.22	13.30	14.37	15.45	16.53	18. 1	19. 9	20.18	21.26	22.34	23.43	24.52	26. 1	26.33	27
28	1. 8	2.16	3.24	4.32	5.40	6.48	7.56	9. 4	10.12	11.21	12.29	13.37	14.46	15.54	17. 3	18.1	19.20	20.29	21.38	22.47	23.57	25. 6	26.16	26.48	28
29	1. 9	2.17	3.26	4.34	5.43	6.52	8. 1	9. 9	10.18	11.27	12.36	13.45	14.54	16. 3	17.13	18.22	19.32	20.41	21.51	23. 1	24.11	25.22	26.32	27. 5	29
30	1. 9	2.19	3.28	4.37	5.47	6.56	8. 5	9.15	10.24	11.34	12.44	13.53	15. 3	16.13	17.23	18.34	19.44	20.54	22. 5	23.16	24.27	25.38	26.49	27.23	30
31	1.10	2.20	3.30	4.40	5.50	7. 0	8.10	9.21	10.31	11.41	12.52	14. 2	15.13	16.24	17.34	18.45	19.57	21. 8	22.19	23.31	24.43	25.55	27. 7	27.41	31
32	1.11	2.22	3.32	4.43	5.54	7. 5	8.16	9.27	10.38	11.49	13. 0	14.11	15.23	16.34	17.46	18.58	20.10	21.22	22.35	23.47	25. 0	26.13	27.26	28. 0	32
33	1.12	2.23	3.35	4.46	5.58	7.10	8.21	9.33	10.45	11.57	13. 9	14.21	15.34	16.46	17.59	19.11	20.24	21.37	22.51	24. 4	25.18	26.32	27.46	28.21	33

TABLE XIX. Amplitudes.

Lat.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	23.28	Lat.
	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	
34°	1.12	2.25	3.37	4.50	6. 2	7.15	8.27	9.4	10.53	12. 5	13.18	14.31	15.44	16.58	18.11	19.25	20.39	21.53	23. 7	24.22	25.3	26.5	28. 7	28.42	34°
35	1.13	2.27	3.40	4.53	6. 6	7.20	8.33	9.47	11. 1	12.14	13.28	14.42	15.56	17.11	18.25	19.40	20.55	22.10	23.25	24.41	25.57	27.1	28.29	29. 5	35
36	1.14	2.28	3.43	4.57	6.11	7.35	8.40	9.54	11. [illegible]	12.24	13.39	14.54	16. 9	17.24	18.39	19.55	21.11	22.27	23.44	25. 1	26.18	27.35	28.53	29.29	36
37	1.15	2.30	3.45	5. 1	6.16	7.31	8.47	10. 2	11.18	12.33	13.49	15. 5	16.2	17.38	18.55	20.11	21.28	22.46	24. 3	25.21	26.40	27.58	29.17	29.55	37
38	1.16	2.32	3.48	5. 5	6.21	7.37	8.54	10.10	11.27	12.44	14. 1	15.18	16.35	17.53	19.10	20.28	21.47	23. 5	24.24	25.43	27. 3	28.23	29.44	30.21	38
39	1.17	2.34	3.52	5. 9	6.26	7.44	9. 1	10.19	11.37	12.55	14.13	15.31	16.50	18. 8	19.27	20.46	22. 6	23.26	24.46	26. 7	27.28	28.49	30.11	30.49	39
40	1.18	2.37	3.55	5.13	6.32	7.51	9. 9	10.28	11.47	13. 6	14.25	15.45	17. 5	18.25	19.45	21. 5	22.26	23.47	25. 9	26.31	27.54	29.17	30.40	31.19	40
41	1.19	2.39	3.59	5.18	6.35	7.58	9.18	10.38	11.58	13.18	14.39	15.59	17.20	18.42	20. 3	21.25	22.48	24.10	25.33	26.57	28.2	29.46	31.11	31.51	41
42	1.21	2.42	4. 2	5.2	6.44	8. 5	9.26	10.48	12. 9	13.31	14.53	16.15	17.37	19. 0	20.23	21.46	23.1	24.34	25.59	27.24	28.50	30.16	31.43	32.24	42
43	1.22	2.44	4. 6	5.28	6.51	8.1	9.36	10.58	12.21	13.44	15. 7	16.31	17.55	19.19	20.44	22. 8	23.34	25.00	26.26	27.53	29.20	30.49	32.18	33.59	43
44	1.23	2.47	4.10	5.34	6.58	8.21	9.45	11. 9	12.3	13.58	15.23	16.4	18.13	19.3	21. 5	22.32	23.59	25.26	26.55	28.23	29.53	31.23	32.54	33.37	44
45	1.25	2.50	4.15	5.40	7. 5	8.30	9.55	11.21	12.47	14.13	15.39	17. 6	18.33	20.0	21.28	22.57	24.25	25.55	27.25	28.56	30.27	31.59	33.33	34.16	45
46	1.26	2.53	4.19	5.46	7.12	8.39	10. 6	11.33	13. 1	14.29	15.54	17.2	18.54	20.23	21.53	23.23	24.53	26.25	27.57	29.30	31. 3	32.38	34.14	34.59	46
47	1.28	2.56	4.24	5.52	7.21	8.49	10.18	11.46	13.16	14.45	16.15	17.45	19.16	20.47	22.18	23.50	25.23	26.57	28.31	30. 6	31.42	33.19	34.57	35.43	47
48	1.30	2.59	4.29	5.59	7.29	8.50	10.30	12. 0	13.31	15. 2	16.34	18. 6	19.39	21.12	22.45	24.20	25.55	27.30	29. 7	30.44	32.23	34. 3	35.44	36.31	48
49	1.31	3. 3	4.35	6. 6	7.38	9.10	10.42	12.15	13.48	15.21	16.54	18.29	20. 3	21.38	23.14	24.51	26.28	28. 6	29.45	31.25	33. 7	34.49	36.32	37.22	49
50	1.33	3. 7	4.40	6.14	7.48	9.22	10.56	12.30	14. 5	15.40	17.16	18.52	20.29	22. 7	23.45	25.24	27. [illegible]	28.44	30.26	32. 9	33.53	35.39	37.26	38.17	50
51	1.35	3.11	4.46	6.22	7.58	9.34	11.10	12.47	14.24	16. 1	17.39	19.17	20.57	22.36	24.17	25.59	27.41	29.25	31. 9	32.55	34.43	36.32	38.23	39.15	51
52	1.37	3.15	4.53	6.30	8. 8	9.47	11.25	13. 4	14.43	16.23	18. 3	19.44	21.26	23. 8	24.52	26.36	28.21	30. 8	31.56	33.45	35.36	37.29	39.24	40.18	52
53	1.40	3.19	4.59	6.39	8.20	10. 0	11.41	13.22	15. 4	16.46	18.20	20.13	21.57	23.42	25.28	27.16	29. 4	30.54	32.45	34.38	36.33	38.30	40.29	41.26	53
54	1.42	3.24	5. 7	6.49	8.32	10.15	11.58	13.42	15.26	17.11	18.57	20.43	22.30	24.18	26. 7	27.58	29.50	31.49	33.38	35.35	37.34	39.36	41.40	42.39	54
55	1.45	3.29	5.14	6.59	8.44	10.30	12.16	14. 3	15.50	17.37	19.26	21.15	23. 5	24.57	26.49	28.43	30.39	32.36	34.35	36.36	38.40	40.47	42.56	43.58	55
56	1.47	3.35	5.22	7.10	8.58	10.46	12.35	14.25	16.15	18. 5	19.57	21.50	23.43	25.38	27.34	29.32	31.31	33.33	35.36	37.42	39.51	42. 4	44.20	45.24	56
57	1.50	3.40	5.31	7.22	9.13	11. 4	12.56	14.48	16.42	18.36	20.30	22.26	24.24	26.22	28.22	30.24	32.28	34.34	36.43	38.54	41. 9	43.27	45.50	46.59	57
58	1.53	3.47	5.40	7.34	9.23	11.23	13.18	15.14	17.10	19. 8	21.36	43. 6	25. 7	27.10	29.14	31.21	33.29	35.40	37.54	40.12	42.33	44.59	47.30	48.43	58
59	1.57	3.53	5.50	7.47	9.45	11.43	13.41	15.41	17.41	19.42	21.45	23.49	25.54	28. 1	30.10	32.21	34.35	36.52	39.12	41.37	44. 6	46.40	49.21	50.38	59
60	2. 0	4. 0	6. 0	8. 1	10. 2	12. 4	14. 6	16.10	18.14	20.10	22.26	24.34	26.44	28.56	31.10	33.27	35.47	38.10	40.38	43.10	45.47	48.31	51.24	52.47	60
61	2. 4	4. 8	6.11	8.16	10.21	12.27	14.34	16.41	18.49	20.59	23.11	25.24	27.39	29.56	32.16	34.39	37. 5	39.36	42.11	44.52	47.40	50.36	53.42	55.13	61
62	2. 8	4.16	6.24	8.33	10.42	12.52	15. 3	17.15	19.28	21.42	23.59	26.17	28.38	31. 1	33.27	35.57	38.31	41.10	43.54	46.46	49.46	52.56	56.20	58. 1	62
63	2.12	4.25	6.37	8.50	11. 4	13.19	15.34	17.51	20. 9	22.29	24.51	27.15	29.42	32.12	34.43	37.23	40. 5	42.54	45.49	48.53	52. 8	55.36	59.23	61.18	63
64	2.17	4.34	6.51	9. 9	11.28	13.48	16. 8	18.31	20.54	23.20	25.48	28.19	30.52	33.30	36.11	38.58	41.50	44.4	47.58	51.17	54.50	58.43	63. 2	65.17	64
65	2.22	4.44	7. 7	9.36	11.54	14.19	16.46	19.1	21.44	4.16	26.50	29.28	32.10	34.55	37.46	40.43	43.46	46.59	50.23	54. 2	57.59	62.25	67.36	79.26	65
66	2.28	4.55	7.24	9.53	12.22	14.54	17.26	20. 1	22.37	25.16	27.59	30.45	33.35	36.30	39.31	42.40	45.57	49.27	53.10	57.14	61.46	67. 4	73.52	78.15	

TABLE XX.

A TABLE shewing the Time of the Sun, Moon, and Stars setting, when the Latitude and Declination are of the same Name; and the Time of its rising, when the Latitude and Declination are of different Names.

DEGREES OF DECLINATION.

Lat.	0	1	2	3	4	5	6	7	8	9	10	11	12
	H M	H M	H M	H M	H M	H M	H M	H M	H M	H M	H M	H M	H M
1	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.01	6.01	6.01	6.01	6.01
2	6.00	6.00	6.00	6.00	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.02	6.02
3	6.00	6.00	6.00	6.01	6.01	6.01	6.01	6.01	6.01	6.02	6.02	6.02	6.03
4	6.00	6.00	6.01	6.01	6.01	6.01	6.02	6.02	6.02	6.03	6.03	6.03	6.03
5	6.00	6.00	6.01	6.01	6.01	6.02	6.02	6.02	6.03	6.03	6.04	6.04	6.04
6	6.00	6.00	6.01	6.01	6.02	6.02	6.03	6.03	6.03	6.04	6.04	6.05	6.05
7	6.00	6.00	6.01	6.01	6.02	6.02	6.03	6.03	6.04	6.04	6.05	6.05	6.06
8	6.00	6.01	6.01	6.02	6.02	6.03	6.03	6.04	6.05	6.05	6.06	6.06	6.07
9	6.00	6.01	6.01	6.02	6.03	6.03	6.04	6.04	6.05	6.05	6.06	6.07	6.08
10	6.00	6.01	6.01	6.02	6.03	6.04	6.04	6.05	6.06	6.06	6.07	6.08	6.09
11	6.00	6.01	6.02	6.02	6.03	6.04	6.05	6.05	6.06	6.07	6.08	6.09	6.09
12	6.00	6.01	6.02	6.03	6.03	6.04	6.05	6.06	6.07	6.08	6.09	6.09	6.10
13	6.00	6.01	6.02	6.03	6.04	6.05	6.06	6.06	6.07	6.08	6.09	6.10	6.11
14	6.00	6.01	6.02	6.03	6.04	6.05	6.06	6.07	6.08	6.09	6.10	6.11	6.12
15	6.00	6.01	6.02	6.03	6.04	6.05	6.06	6.08	6.09	6.10	6.11	6.12	6.13
16	6.00	6.01	6.02	6.03	6.05	6.06	6.07	6.08	6.09	6.10	6.12	6.13	6.14
17	6.00	6.01	6.02	6.04	6.05	6.06	6.07	6.09	6.10	6.11	6.12	6.14	6.15
18	6.00	6.01	6.03	6.04	6.05	6.07	6.08	6.09	6.10	6.12	6.13	6.14	6.16
19	6.00	6.01	6.03	6.04	6.06	6.07	6.08	6.10	6.11	6.13	6.14	6.15	6.17
20	6.00	6.01	6.03	6.04	6.06	6.07	6.09	6.10	6.12	6.13	6.15	6.16	6.18
21	6.00	6.02	6.03	6.05	6.06	6.08	6.09	6.11	6.12	6.14	6.16	6.17	6.19
22	6.00	6.02	6.03	6.05	6.06	6.08	6.10	6.11	6.13	6.15	6.16	6.18	6.20
23	6.00	6.02	6.03	6.05	6.07	6.09	6.10	6.12	6.14	6.15	6.17	6.19	6.21
24	6.00	6.02	6.04	6.05	6.07	6.09	6.11	6.13	6.14	6.16	6.18	6.20	6.22
25	6.00	6.02	6.04	6.06	6.07	6.09	6.11	6.13	6.15	6.17	6.19	6.21	6.23
26	6.00	6.02	6.04	6.06	6.08	6.10	6.12	6.14	6.16	6.18	6.20	6.22	6.24
27	6.00	6.02	6.04	6.06	6.08	6.10	6.12	6.14	6.16	6.19	6.21	6.23	6.25
28	6.00	6.02	6.04	6.06	6.09	6.11	6.13	6.15	6.17	6.19	6.22	6.24	6.26
29	6.00	6.02	6.04	6.07	6.09	6.11	6.13	6.16	6.18	6.20	6.22	6.25	6.27
30	6.00	6.02	6.05	6.07	6.09	6.12	6.14	6.16	6.19	6.21	6.23	6.26	6.28

13	14	15	16	17	18	19	20	21	22	23	23.28	Lat.
H M	H M	H M	H M	H M	H M	H M	H M	H M	H M	H M	H M	
6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.02	6.02	6.02	6.02	1°
6.02	6.02	6.02	6.02	6.02	6.03	6.03	6.03	6.03	6.03	6.03	6.03	2
6.03	6.03	6.03	6.03	6.04	6.04	6.04	6.04	6.05	6.05	6.05	6.05	3
6.04	6.04	6.04	6.05	6.05	6.05	6.06	6.06	6.06	6.06	6.07	6.07	4
6.05	6.05	6.05	6.06	6.06	6.07	6.07	6.07	6.08	6.08	6.09	6.09	5
6.06	6.06	6.06	6.07	6.07	6.08	6.08	6.09	6.09	6.10	6.10	6.10	6
6.06	6.07	6.08	6.08	6.09	6.09	6.10	6.10	6.11	6.11	6.12	6.12	7
6.07	6.08	6.09	6.09	6.10	6.10	6.11	6.12	6.12	6.13	6.14	6.14	8
6.08	6.09	6.10	6.10	6.11	6.12	6.13	6.13	6.14	6.15	6.15	6.16	9
6.09	6.10	6.11	6.12	6.12	6.13	6.14	6.15	6.16	6.16	6.17	6.18	10
6.10	6.11	6.12	6.13	6.14	6.14	6.15	6.16	6.17	6.18	6.19	6.19	11
6.11	6.12	6.13	6.14	6.15	6.16	6.17	6.18	6.19	6.20	6.21	6.21	12
6.12	6.13	6.14	6.15	6.16	6.17	6.18	6.19	6.20	6.21	6.22	6.23	13
6.13	6.14	6.15	6.16	6.17	6.19	6.20	6.21	6.22	6.23	6.24	6.25	14
6.14	6.15	6.16	6.18	6.19	6.20	6.21	6.22	6.24	6.25	6.26	6.27	15
6.15	6.16	6.18	6.19	6.20	6.21	6.23	6.24	6.25	6.27	6.28	6.29	16
6.16	6.17	6.19	6.20	6.21	6.23	6.24	6.26	6.27	6.28	6.30	6.31	17
6.17	6.19	6.20	6.21	6.23	6.24	6.26	6.27	6.29	6.30	6.32	6.32	18
6.18	6.20	6.21	6.23	6.24	6.26	6.27	6.29	6.30	6.32	6.34	6.34	19
6.19	6.21	6.22	6.24	6.26	6.27	6.29	6.30	6.32	6.34	6.36	6.36	20
6.20	6.22	6.24	6.25	6.27	6.29	6.30	6.32	6.34	6.36	6.38	6.38	21
6.21	6.23	6.25	6.27	6.29	6.30	6.32	6.34	6.36	6.38	6.39	6.40	22
6.22	6.24	6.26	6.28	6.30	6.32	6.34	6.36	6.38	6.39	6.42	6.42	23
6.24	6.25	6.27	6.29	6.31	6.33	6.35	6.37	6.39	6.41	6.44	6.45	24
6.25	6.27	6.29	6.31	6.33	6.35	6.37	6.39	6.41	6.43	6.46	6.47	25
6.26	6.28	6.30	6.32	6.34	6.36	6.39	6.41	6.43	6.45	6.48	6.49	26
6.27	6.29	6.31	6.34	6.36	6.38	6.40	6.43	6.45	6.48	6.50	6.51	27
6.28	6.30	6.33	6.35	6.37	6.40	6.42	6.45	6.47	6.50	6.52	6.53	28
6.29	6.32	6.34	6.37	6.39	6.42	6.44	6.47	6.49	6.52	6.54	6.56	29
6.31	6.33	6.36	6.38	6.41	6.43	6.46	6.49	6.51	6.54	6.57	6.58	30

A TABLE shewing the Time of the Sun, Moon, and Star's setting, when the Latitude and Declination are of the same Name; and the Time of its rising, when the Latitude and Declination are of different Names.

DEGREES OF DECLINATION.

Lat.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	23.28	Lat.
	H M	H M	H M	H M	H M	H M	H M	H M	H M	H M	H M	H M	H M	H M	H M	H M	H M	H M	H M	H M	H M	H M	H M	H M	H M	
31°	6.00	6.02	6.05	6.07	6.10	6.12	6.14	6.17	6.19	6.22	6.24	6.27	6.29	6.32	6.34	6.37	6.40	6.42	6.45	6.48	6.51	6.53	6.56	6.59	7.00	31°
32	6.00	6.02	6.05	6.08	6.10	6.13	6.15	6.18	6.20	6.23	6.25	6.28	6.31	6.33	6.36	6.39	6.41	6.44	6.47	6.50	6.53	6.56	6.58	7.02	7.03	32
33	6.00	6.03	6.05	6.08	6.10	6.13	6.16	6.18	6.21	6.24	6.26	6.29	6.32	6.34	6.37	6.40	6.43	6.46	6.49	6.52	6.55	6.58	7.01	7.04	7.05	33
34	6.00	6.03	6.05	6.08	6.11	6.14	6.16	6.19	6.22	6.25	6.27	6.30	6.33	6.36	6.39	6.42	6.45	6.48	6.51	6.54	6.57	7.00	7.03	7.07	7.08	34
35	6.00	6.03	6.06	6.08	6.11	6.14	6.17	6.20	6.23	6.25	6.28	6.31	6.34	6.37	6.40	6.43	6.46	6.49	6.53	6.56	6.59	7.02	7.06	7.09	7.11	35
36	6.00	6.03	6.06	6.09	6.12	6.15	6.18	6.20	6.23	6.26	6.29	6.32	6.36	6.39	6.42	6.45	6.48	6.51	6.55	6.58	7.01	7.05	7.08	7.12	7.14	36
37	6.00	6.03	6.06	6.09	6.12	6.15	6.18	6.21	6.24	6.27	6.31	6.34	6.37	6.40	6.43	6.47	6.50	6.53	6.57	7.00	7.04	7.07	7.11	7.15	7.16	37
38	6.00	6.03	6.06	6.09	6.13	6.16	6.19	6.22	6.25	6.28	6.32	6.35	6.38	6.42	6.45	6.48	6.52	6.55	6.59	7.02	7.06	7.10	7.14	7.17	7.19	38
39	6.00	6.03	6.06	6.10	6.13	6.16	6.20	6.23	6.26	6.29	6.33	6.36	6.40	6.43	6.47	6.50	6.54	6.57	7.01	7.05	7.09	7.12	7.16	7.20	7.22	39
40	6.00	6.03	6.07	6.10	6.13	6.17	6.20	6.24	6.27	6.31	6.34	6.38	6.41	6.45	6.48	6.52	6.56	6.59	7.03	7.07	7.11	7.15	7.19	7.23	7.25	40
41	6.00	6.03	6.07	6.10	6.14	6.17	6.21	6.25	6.28	6.32	6.35	6.39	6.43	6.46	6.50	6.54	6.58	7.02	7.06	7.10	7.14	7.18	7.22	7.27	7.29	41
42	6.00	6.04	6.07	6.11	6.14	6.18	6.22	6.25	6.29	6.33	6.37	6.40	6.44	6.48	6.52	6.56	7.00	7.04	7.08	7.12	7.17	7.21	7.25	7.30	7.32	42
43	6.00	6.04	6.07	6.11	6.15	6.19	6.22	6.26	6.30	6.34	6.38	6.42	6.46	6.50	6.54	6.58	7.02	7.06	7.11	7.15	7.19	7.24	7.29	7.33	7.36	43
44	6.00	6.04	6.08	6.12	6.15	6.19	6.23	6.27	6.31	6.35	6.39	6.43	6.47	6.52	6.56	7.00	7.04	7.09	7.13	7.18	7.22	7.27	7.32	7.37	7.39	44
45	6.00	6.04	6.08	6.12	6.16	6.20	6.24	6.28	6.32	6.36	6.41	6.45	6.49	6.53	6.58	7.02	7.07	7.11	7.16	7.21	7.25	7.30	7.35	7.40	7.43	45
46	6.00	6.04	6.08	6.12	6.17	6.21	6.25	6.29	6.33	6.38	6.42	6.46	6.51	6.55	7.00	7.04	7.09	7.14	7.19	7.24	7.29	7.34	7.39	7.44	7.47	46
47	6.00	6.04	6.09	6.13	6.17	6.22	6.26	6.30	6.35	6.39	6.44	6.48	6.53	6.57	7.02	7.07	7.12	7.17	7.22	7.27	7.32	7.37	7.43	7.48	7.51	47
48	6.00	6.04	6.09	6.13	6.18	6.22	6.27	6.31	6.36	6.41	6.45	6.50	6.55	6.59	7.04	7.09	7.14	7.19	7.25	7.30	7.35	7.41	7.47	7.53	7.55	48
49	6.00	6.05	6.09	6.14	6.18	6.23	6.28	6.32	6.37	6.42	6.47	6.52	6.57	7.02	7.07	7.12	7.17	7.22	7.28	7.33	7.39	7.45	7.51	7.57	8.00	49
50	6.00	6.05	6.10	6.14	6.19	6.24	6.29	6.34	6.39	6.44	6.49	6.54	6.59	7.04	7.09	7.14	7.20	7.25	7.31	7.37	7.43	7.49	7.55	8.02	8.05	50
51	6.00	6.05	6.10	6.15	6.20	6.25	6.30	6.35	6.40	6.45	6.50	6.56	7.01	7.06	7.12	7.17	7.23	7.29	7.35	7.41	7.47	7.53	8.00	8.09	8.10	51
52	6.00	6.05	6.10	6.15	6.21	6.26	6.31	6.36	6.41	6.47	6.52	6.58	7.03	7.09	7.14	7.20	7.26	7.32	7.38	7.45	7.51	7.58	8.05	8.12	8.15	52
53	6.00	6.05	6.11	6.16	6.21	6.27	6.32	6.38	6.43	6.49	6.54	7.00	7.06	7.11	7.17	7.23	7.29	7.36	7.42	7.49	7.56	8.02	8.10	8.17	8.21	53
54	6.00	6.06	6.11	6.17	6.22	6.28	6.33	6.39	6.45	6.50	6.56	7.02	7.08	7.14	7.20	7.27	7.33	7.40	7.46	7.53	8.00	8.08	8.15	8.23	8.27	54
55	6.00	6.06	6.11	6.17	6.23	6.29	6.35	6.40	6.46	6.52	6.58	7.04	7.11	7.17	7.23	7.30	7.37	7.44	7.51	7.58	8.05	8.13	8.21	8.29	8.33	55
56	6.00	6.06	6.12	6.18	6.24	6.30	6.36	6.42	6.48	6.54	7.01	7.07	7.13	7.20	7.27	7.34	7.41	7.48	7.55	8.03	8.11	8.19	8.27	8.36	8.40	56
57	6.00	6.06	6.12	6.19	6.25	6.31	6.37	6.44	6.50	6.56	7.03	7.10	7.16	7.23	7.30	7.37	7.45	7.52	8.00	8.08	8.16	8.25	8.34	8.43	8.48	57
58	6.00	6.06	6.13	6.19	6.26	6.32	6.39	6.45	6.52	6.59	7.06	7.12	7.20	7.27	7.34	7.42	7.49	7.57	8.05	8.14	8.22	8.32	8.41	8.51	8.56	58
59	6.00	6.07	6.13	6.20	6.27	6.33	6.40	6.47	6.54	7.01	7.08	7.15	7.23	7.30	7.38	7.46	7.54	8.02	8.11	8.20	8.29	8.39	8.49	9.00	9.05	59
60	6.00	6.07	6.14	6.21	6.28	6.35	6.42	6.49	6.56	7.04	7.11	7.19	7.26	7.34	7.42	7.51	7.59	8.08	8.17	8.26	8.36	8.47	8.58	9.09	9.15	

Table XX.

To find the Time of the Sun's Riſing, Setting, and the Length of the Day and Night, by this Table.

Firſt. Find the ſun's declination at the top of the page (marked with the degrees of declination) and the latitudes in the right or left hand columns (marked lat.) and in the common angle of meeting is the time of ſun ſetting, if the ſun has north declination, but the time of ſun riſing, if the ſun has ſouth declination.

EXAMPLE I.

Let it be required to find the time of the ſun's riſing and ſetting, with the length of the day and night, in lat. 51° north, the 26th day of May, 1809?

I firſt ſeek the ſun's declination for the given day, and find it 21° 6′ N. then under the declination 21, and againſt the latitude 51°, ſtands 7 H. 53 M. the time the ſun ſets on the given day, in lat. 51 north, which being doubled, gives 15 H. 46 M. the length of the day; and if 7 H. 53 M. the time of the ſun ſetting, be ſubtracted from 12 H. the remainder 4 H. 7 M. gives the time of the ſun's riſing, which being doubled, gives 8 H. 14 M. length of the night.

But, when the ſun has 21° ſouth declination in this latitude, the time of ſun-ſetting becomes the time of ſun-riſing, and the length of the day will then become the length of the night.

Thus, on the 26th of November, 1809, the ſun's declination will be 20° 57′ or 21° S. then the time of ſun-riſing is 7 H. 53 M. his ſetting 4 H. 7 M. and the length of the night 15 H. 46 M. and day 8 H. 14 M.

EXAMPLE II.

Let it be required to find the time of the ſun's riſing, ſetting, and length of the day and night, at Peterſburg, the 21ſt June, 1809.

Under 23° 28′ N. the declination that day, and againſt 60° N. the latitude of Peterſburg,	12	0
Stands the ſun's ſetting —	9	15
The time of ſun-riſing —	2	45
Sun-ſetting doubled is the length of day	18	30
Sun-riſing doubled is the length of night	5	30

EXAMPLE III.

Required the time of the ſun's riſing and ſetting, and length of day at the Cape of Good Hope, in lat. 34. 29 S. May 16th, 1809.

Under the declination 19° 4′ or 19° N. and againſt the lat. 34 S. Stands the ſun's riſing -	12	0
	6	54
Time of ſun's ſetting -	5	6
		2
The length of the day - -	10	12
And 6H. 54M. doub. is length of night	13	48

When a greater degree of accuracy is required, proportional parts may be taken for degrees and minutes of latitude and declination.

To find the Riſing and Setting of the Stars.

By this table the riſing and ſetting of any ſtar may be found, whoſe declination does not exceed 23° 28′ north or ſouth, in the following manner:

It you are in north lat. and the ſtar has north declination, look for the declination at the top, and the lat. in the right or left hand columns, in the angle of meeting, is half the time of the ſtar's continuance above the horizon, in that lat. or the time it takes in aſcending from the eaſtern ſide of the horizon to the meridian, and deſcending from the meridian to the weſtern part of the horizon.

Eherefore, if theſe hours and minutes be ſubtracted from the time of the ſtar's coming to the meridian, the remainder will be the time of the ſtar's riſing, and if added, the ſum will be the time of the ſtar's ſetting.

EXAMPLE I.

Required when the ſtar Arcturus riſes and ſets December 1, in lat. 51 deg. N.

The time of the ſtar's coming to the meridian, or ſouthing in the morning	9	39
Then under ſtar's declination 20° 11′ 50″ N. and againſt lat. 51 ſtands	7	47
Time of ſtar's riſing in the morning —	1	52
Added, gives the time of the ſtar's ſetting —	17	26
	12	
Star ſets 26 minutes after 5 in the evening —	5	26

When the latitude is north, and the ſtar has ſouth declination, or the latitude ſouth and the ſtar has north declination, find the latitude in the ſide columns as before, againſt which, and under the degrees of declination, ſtands half the time

the star is under the horizon, which being subtracted from 12, the remainder will be half the time the star will be above the horizon in that latitude.

Example. What time will the Dog Star, Sirius, rise and set at London, January 25?

	12
under the declination 16° 27′ S. and against lat. 51° 32′ or 52° stands	7 26
Half the time the star is above the horizon — —	4 34
The star comes to the meridian in the evening, at —	10 05
Which subtracted, shews that the star rises at 31 m. after 5 in the evening	5 31
Added, shews the time the star sets in the morning —	2 39

In like manner may the rising and setting of the planets be found when their declination does not exceed 23°, and the time of their passage over the meridian is known.

Suppose it were required to know the time of Jupiter's rising and setting, in latitude 52 north the 1st of November, 1807.

In the Nautical Almanack for 1807, I find that Jupiter passes over the meridian of Greenwich at 6 H. 3 M. and his declination is 20° 0′ S.

Now, 12 H. added to 6 H. 3 M. is 18 H. 3 M. from which subtract 12 H. and the remainder 6 H. 3 M. is the time of his passing the meridian in the morning of that day, according to the civil account.

Under declination 20° and against latitude 52° stand 7 H. 51 M. half the time Jupiter is below the horizon; this doubled is 15 H. 42 M. the length of Jupiter's night, which subtracted from 24 H. gives 8 H. 18 M. the length of his day.

Again, 7 H. 51 M. added to his passing the meridian 6 H. 3 M. gives 13 H. 54 M. or 1 H. 54 M. the time of his rising in the morning, and 6 H. 3 M. added to 12 H. gives 18 H. 3 M. from this sum take 7 H. 51 M. and the remainder 10 H. 12 M. is the time of his setting in the morning.

Suppose it were required to find the moon's rising and setting October 18th 1806, in latitude 52° north.

In the Nautical Almanack, (page 6th) I find that the moon passes the meridian of Greenwich at 5 H. 40 M. in the evening, and her declination at midnight is 19° 29′ South.

Then in the Tables, under the declination 19° 29′ S. and against the lat. 52°, stands 7 H. 47 M. Half the time she is under the horizon doubled is 15 H. 34 M. the length of the lunar night, which subtracted from 24 H. leaves 8 H. 26 M. the lunar day. To the moon's southing or passage over the meridian, 5 H. 40 M. add half the lunar day, 4 H. 13 M. gives 9 H. 53 M. her setting at midnight, and from 5 H. 40 M. take 4,13, the remainder 1 H. 9 M. is the time of her rising in the afternoon.

In like manner may be found the rising and setting of the other planets, only observing that the noon of the common day, and end of the sea day, is the beginning of the day in the Nautical Almanack.

As all the calculations here are made for the meridian of London, or Greenwich, care must be taken to reduce the time of their passages over the meridian of Greenwich to the meridian of the place of observation, by allowing 1 H. later for every 15° of west longitude, and 1 H. sooner for every 15° of east Longitude.

It were to be wished, that gentlemen belonging to the sea would carry a celestial globe with them, upon which all the above may be found in an easy manner; for they would have nothing more to do but to set the globe north and south, raise the pole as many degrees above the horizon as the latitude is; bring the sun's place to the brazen meridian, and set the index to the upper 12; then turn the globe round, and note what stars come to the meridian, and the hour index will point to the time; when they come above the horizon, it will point to the time of their rising, and when they descend below the horizon, it will point to their setting; for as each star on the globe will point directly to one of the same name in the heavens, they may be viewed at any time of the night; or, if a planet, turn the globe until the index points to the time of their passage over the meridian, and make a mark on the globe with a pencil, under their declination, then turn the globe east until the mark comes to the horizon, and the index will point to the time of their rising; and turned westerly till it come to the horizon, the index will point to the time of their setting.

TABLE XXI.

For Finding the Diſtance of Terreſtrial Objects at Sea.

Ht. Ft.	Diſt. M.	Diſt. D.	Ht. Ft.	Diſt. M.	Diſt. D.	Ht. Ft.	Diſt. M.	Diſt. D.	Ht. Ft.	Diſt. M.	Diſt. D.
1	1.	32	44	8.	78	320	23.	67	1000	41.	[illegible]
2	1.	87	45	8.	87	330	24.	03	1100	43.	[illegible]
3	2.	29	46	8.	97	340	24.	39	1200	45.	[illegible]
4	2.	65	47	9.	07	350	24.	75	1300	47.	[illegible]
5	2.	96	48	9.	17	360	25.	10	1400	49.	[illegible]
6	3.	24	49	9.	26	370	25.	45	1500	51.	[illegible]
7	3.	50	50	9.	35	380	25.	79	1600	52.	[illegible]
8	3.	74	55	9.	81	390	26.	13	1700	54.	[illegible]
9	3.	97	60	10.	25	400	26.	46	1800	56.	[illegible]
10	4.	18	65	10.	67	410	26.	79	1900	57.	[illegible]
11	4.	39	70	11.	07	420	27.	11	2000	59.	[illegible]
12	4.	58	75	11.	46	430	27.	43	2100	60.	[illegible]
13	4.	77	80	11.	83	440	27.	75	2200	62.	[illegible]
14	4.	95	85	12.	20	450	28.	06	2300	63.	[illegible]
15	5.	12	90	12.	55	460	28.	37	2400	64.	[illegible]
16	5.	29	95	13.	89	470	28.	68	2500	66.	[illegible]
17	5.	45	100	13.	23	480	28.	98	2600	67.	[illegible]
18	5.	61	105	13.	56	490	29.	29	2700	68.	[illegible]
19	5.	77	110	13.	88	500	29.	58	2800	70.	[illegible]
20	5.	92	115	14.	19	520	30.	17	2900	71.	[illegible]
21	6.	06	120	14.	49	540	30.	74	3000	72.	[illegible]
22	6.	21	125	14.	79	560	31.	31	3100	73.	[illegible]
23	6.	34	130	15.	08	580	31.	86	3200	74.	[illegible]
24	6.	48	135	15.	37	600	32.	41	3300	76.	[illegible]
25	6.	61	140	15.	65	620	32.	94	3400	77.	[illegible]
26	6.	75	145	15.	93	640	33.	47	3500	78.	[illegible]
27	6.	87	150	16.	20	660	33.	99	3600	79.	[illegible]
28	7.	00	160	16.	73	680	34.	50	3700	80.	[illegible]
29	7.	12	170	17.	25	700	35.	00	3800	81.	[illegible]
30	7.	25	180	17.	75	720	35.	50	3900	82.	[illegible]
31	7.	37	190	18.	24	740	35.	99	4000	83.	[illegible]
32	7.	48	200	18.	71	760	36.	47	4100	84.	[illegible]
33	7.	60	210	19.	17	780	36.	95	4200	85.	[illegible]
34	7.	71	220	19.	62	800	37.	42	4300	86.	[illegible]
35	7.	83	230	20.	06	820	37.	88	4400	87.	[illegible]
36	7.	94	240	20.	50	840	38.	34	4500	88.	[illegible]
37	8.	05	250	20.	92	860	38.	80	4600	89.	[illegible]
38	8.	16	260	21.	33	880	39.	25	4700	90.	[illegible]
39	8.	26	270	21.	74	900	39.	69	4800	91.	[illegible]
40	8.	37	280	22.	14	920	40.	13	4900	92.	[illegible]
41	8.	47	290	22.	53	940	40.	56	5000	93.	[illegible]
42	8.	57	300	22.	91	960	40.	99	1 M.	96.	[illegible]
43	8.	68	310	23.	29	980	41.	42			

TABLE XXII.

Proportion of Powder for Sea Guns.

Pdrs.	Proof.	Service.	Saluting.	Scaling.
	lb. oz.	lb. oz.	lb. oz.	lb. oz.
42	25. 0	14. 0	10. 0	3. 0
32	21. 0	10.11	8. 0	2.12
24	18. 0	8. 0	6. 0	2. 0
18	15. 0	6. 0	4. 8	1. 8
12	12. 0	4. 0	3. 0	1. 0
9	9. 0	3. 0	2. 4	0.12
6	6. 0	2. 0	2. 0	0. 8
4	4. 0	1. 5	1. 5	0. 6
3	3. 0	1. 0	1. 0	0. 4
½	0. 8	0. 3	0. 3	0. 1
Caronades.				
42	9. 0	4. 8	4. 8	1. 8
32	8. 0	4. 0	4. 0	1. 4
24	6. 0	3. 0	3. 0	1. 0
18	4. 0	2. 0	2. 0	1. 0
12	3. 0	1. 8	1. 8	0.12
Wall Pieces.				
	2.8	0.10		
Musquets.				
	0.12	0. 6		
Piſtols.				
	0. 6	0. 3		

N.B These proportions are with powder in good condition; if it is damp, or damaged, a greater quantity will be neceſſary.

A TABLE of the Number and ſorts of Shot contained in the Grapes for the nature of Guns undermentioned.

Pdrs.	Shot.	No. in each.	No. in each box
42	4lb.	9	4
32	3	9	4
24	2	9	6
18	1½	9	8
12	1	9	10
	Oz.		
9	13	9	12
6	8	9	20
4	6	9	20

Table XXIII. For finding the Latitude by two Altitudes of the Sun.

Half elapsed Time.

0 Hour.

M.	0″	10″	20″	30″	40″	50″
0		13833	83730	66121	53627	43936
1	2.36018	29324	23525	18409	13834	09695
2	05916	02440	99221	96225	93422	90790
3	1.88307	85959	83732	81613	79593	77663
4	75814	74042	72339	70700	69121	67597
5	66125	64701	63322	61986	60690	59431
6	58208	57018	55861	54733	53634	52561
7	51515	50494	59496	48520	47566	46632
8	45716	44923	43946	43086	42243	41417
9	40605	39809	39027	38258	37502	36762
10	1.36032	35313	34609	33915	33231	32555
11	31896	31243	30600	29967	29342	28727
12	28120	27522	26931	26349	25774	25207
13	24647	24095	23549	23010	22477	21952
14	21432	20919	20412	19910	19415	18925
15	18440	17961	17487	17018	16554	16096
16	15642	15192	14748	14307	13872	13440
17	13013	12590	12171	11757	11346	10939
18	10536	10136	09740	09348	08960	08575
19	08193	07814	07439	07067	06698	06333
20	1.05970	05610	05254	04901	04550	04202
21	03857	03515	03175	02838	02504	02172
22	01843	01516	01192	00870	00550	00234
23	0.99918	99606	99296	98988	98682	98378
24	98077	97777	97480	97184	96891	96600
25	96310	96023	95738	95454	95172	94892
26	94614	94338	94063	93790	93519	93250
27	92982	92716	92452	92189	91928	91669
28	91411	94154	90899	90646	90394	90143
29	89894	89647	89401	89156	88913	88671
30	0.88430	88191	87953	87717	87482	87247
31	87015	86783	86553	86324	86096	85870
32	85644	85420	85197	84976	84755	84535
33	84317	84100	83884	83669	83455	83242
34	83030	82819	82609	82401	82193	81986
35	81780	81576	81372	81169	80967	80767
36	80567	80368	80170	79973	79777	79581
37	79387	79193	79001	78809	78618	78429
33	78239	78051	77863	77677	77491	77306
39	77122	76938	76756	76574	76393	76212
40	0.76033	75854	75676	75499	75323	75147
41	74972	74797	74624	74451	74279	74107
42	73937	73767	73597	73429	73261	73093
43	72926	72760	72595	72430	72266	72103
44	71940	71778	71616	71455	71295	71135
45	70976	70818	70660	70503	70346	70190
46	70034	69879	69725	69571	69418	69265
47	69113	68962	68811	68660	68510	68361
48	68212	68064	67916	67764	67622	67476
49	67330	67185	67040	66896	66752	66609
50	0.66466	66324	66182	66041	65900	65760
51	65620	65481	65342	65204	65066	64928
52	64791	64655	64519	64383	64248	64113
53	63978	63844	63711	63578	63445	63313
54	63181	63050	62919	62789	62659	62529
55	62400	62271	62142	62014	61886	61759
56	61632	61506	61380	61254	61129	61004
57	60879	60755	60631	60508	60385	60262
58	60140	60018	59896	59775	59654	59534
59	59414	59294	59175	59056	58937	58818

1 Hour.

M.	0″	10″	20″	30″	40″	50″
0	0.58700	58582	58465	58348	58231	58115
1	57999	57883	57768	57653	57538	57424
2	57310	57196	57083	56970	56857	56745
3	56633	56521	56409	56298	56187	56076
4	55966	55856	55746	55637	55528	55419
5	55311	55203	55095	54988	54880	54773
6	54666	54559	54453	54347	54241	54136
7	54031	53926	53822	53718	43614	53510
8	53406	53303	53200	53097	52995	52893
9	52791	52690	52589	52488	52387	52286
10	0.52186	52086	51986	51886	51787	51688
11	51589	51490	51392	51294	51196	51099
12	51002	50905	50809	50711	50615	50519
13	50423	50327	50232	50137	50042	49947
14	49852	49758	49664	49570	49476	49383
15	49290	49197	49104	49012	48920	48828
16	48736	48644	48553	48462	48371	48280
17	48189	48099	48009	47919	47829	47739
18	47650	47561	47472	47383	47295	47207
19	47119	47031	46943	46856	46769	46682
20	0.46595	46508	46421	46335	46249	46163
21	46077	45992	45907	45822	45737	45652
22	45567	45583	45399	45315	45231	45147
23	45064	44981	44898	44815	44732	44649
24	44567	44485	44403	44321	44239	44158
25	44077	43996	43915	43834	43753	43673
26	43593	43513	43433	43353	43273	43193
27	43114	43035	42956	42877	42799	42721
28	42643	42565	42487	42409	42331	42253
29	42176	42099	42022	41945	41868	41792
30	0.41716	41640	41564	41488	41412	41336
31	41261	41186	41111	41036	40961	40886
32	40812	40738	40664	40590	40516	40442
33	40368	40295	40222	40149	40076	40003
34	39930	39857	39785	39713	39641	39569
35	39497	39425	39353	39282	39211	39140
36	39069	38998	38927	38856	38786	38716
37	38646	38576	38506	38436	38366	38296
38	38227	38158	38089	38020	37951	37882
39	37813	37745	37677	37609	37541	37473
40	0.37405	37337	37269	37202	37135	37068
41	37001	36934	36867	36800	36734	36668
42	36602	36536	36470	36404	36338	36272
43	36206	36141	36076	36011	35946	35881
44	35816	35751	35686	35622	35558	35494
45	35430	35366	35302	35238	35174	35110
46	35047	34984	34921	34858	34795	34732
47	34669	34606	34544	34482	34420	34358
48	34296	34234	34172	34110	34048	33986
49	33925	33864	33803	33742	33681	33620
50	0.33559	33498	33438	33378	33318	33258
51	33197	33137	33077	33017	32957	32899
52	32839	32780	32720	32661	32602	32543
53	32485	32426	32367	32309	32250	32192
54	32134	32076	32018	31960	31902	31844
55	31787	31729	31672	31614	31557	31500
56	31443	31386	31329	31272	31216	31159
57	31103	31046	30990	30934	30878	30822
58	30766	30710	30655	30599	30544	30488
59	30433	30378	30323	30268	30213	30158

TABLE XXIII. For finding the Latitude by two Altitudes of the Sun.

Half Elapsed Time.

M	2 Hours. 0″	10″	20″	30″	40″	50″	M	3 Hours. 0″	10″	20″	30″	40″	50″
0	0.30103	30048	29994	29939	29885	29831	0	0.15051	15020	14988	14957	14926	14894
1	29776	29721	29668	29614	29560	29507	1	14863	14832	14800	14769	14738	14707
2	29453	29399	29346	29293	29239	29186	2	14676	14645	14614	14583	14552	14521
3	29133	29080	29027	28974	28921	28869	3	14490	14460	14429	14398	14368	14337
4	28816	28764	28711	28659	28607	28554	4	14307	14276	14246	14215	14185	14155
5	28502	28450	28398	28346	28295	28243	5	14124	14094	14064	14034	14004	13974
6	28191	28140	28089	28037	27986	27935	6	13944	13914	13884	13854	13824	13794
7	27884	27833	27782	27731	27680	27630	7	13765	13735	13705	13676	13646	13617
8	27579	27529	27478	27428	27378	27327	8	13587	13558	13528	13499	13470	13441
9	27277	27227	27177	27127	27077	27028	9	13411	13382	13353	13324	13295	13266
10	0.26978	26929	26879	26830	26781	26731	10	0.13237	13208	13179	13150	13121	13093
11	26682	26633	26584	26535	26486	26438	11	13064	13035	13007	12978	12950	12921
12	26389	26340	26292	26244	26195	26147	12	12893	12864	12836	12807	12779	12751
13	26099	26051	26003	25955	25907	25859	13	12723	12695	12666	12638	12610	12582
14	25811	25763	25716	25668	25621	25573	14	12554	12526	12499	12471	12443	12415
15	25526	25479	25432	25385	25338	25291	15	12387	12360	12332	12304	12277	12249
16	25244	25197	25150	25104	25057	25011	16	12222	12195	12167	12140	12112	12085
17	24964	24918	24872	24826	24779	24733	17	12058	12031	12004	11977	11949	11922
18	24687	24641	24595	24550	24504	24458	18	11895	11868	11842	11815	11788	11761
19	24413	24367	24322	24276	24231	24186	19	11734	11708	11681	11654	11628	11601
20	0.24141	24096	24051	24006	23961	23916	20	0.11575	11548	11522	11495	11469	11443
21	23871	23827	23782	23738	23693	23649	21	11417	11390	11364	11333	11312	11285
22	23605	23561	23516	23472	23428	23384	22	11259	11233	11207	11181	11155	11130
23	23340	23296	23252	23209	23165	23122	23	11104	11078	11052	11027	11001	10975
24	23078	23035	22991	22948	22905	22862	24	10950	10924	10899	10873	10848	10822
25	22819	22775	22732	22690	22647	22604	25	10797	10772	10746	10721	10696	10671
26	22561	22519	22476	22433	22391	22349	26	10646	10620	10595	10570	10545	10520
27	22306	22264	22222	22180	22138	22096	27	10495	10471	10446	10421	10396	10371
28	22054	22012	21970	21928	21887	21845	28	10347	10322	10297	10272	10248	10224
29	21803	21762	21720	21679	21638	21596	29	10199	10175	10151	10126	10102	10078
30	0.21555	21514	21473	21432	21391	21350	30	0.10053	10029	10005	09981	09957	09933
31	21309	21268	21228	21187	21147	21106	31	09909	09885	09861	09837	09813	09789
32	21066	21025	20985	20945	20905	20864	32	09765	09741	09718	09694	09670	09647
33	20814	20784	20744	20704	20665	20625	33	09623	09599	09576	09552	09529	09506
34	20585	20545	20506	20466	20427	20387	34	09482	09459	09435	09412	09389	09366
35	20348	20309	20269	20230	20191	20152	35	09343	09319	09296	09273	09250	09227
36	20113	20074	20035	19996	19957	19919	36	09204	09181	09158	09136	09113	09090
37	19880	19841	19803	19764	19726	19687	37	09067	09044	09022	08999	08976	08954
38	19649	19611	19572	19534	19496	19458	38	08931	08909	08886	08864	08842	08819
39	19420	19382	19344	19306	19269	19231	39	08797	08774	08752	08730	08708	08686
40	0.19193	19156	19118	19081	19043	19006	40	0.08664	08641	08619	08597	08575	08553
41	18968	18931	18894	18857	18820	18783	41	08531	08510	08488	08466	08444	08422
42	18746	18709	18672	18635	18598	18561	42	08401	08379	08357	08336	08314	08293
43	18525	18488	18451	18415	18378	18342	43	08271	08250	08228	08207	08185	08164
44	18306	18269	18233	18197	18161	18124	44	08143	08121	08100	08079	08058	08036
45	18089	18053	18017	17981	17945	17909	45	08015	07994	07973	07952	07931	07910
46	17874	17838	17802	17767	17731	17696	46	07889	07868	07848	07827	07806	07785
47	17660	17625	17590	17554	17519	17484	47	07765	07744	07723	07703	07682	07661
48	17449	17414	17379	17344	17309	17274	48	07641	07620	07600	07579	07559	07539
49	17239	17205	17170	17135	17101	17066	49	07518	07498	07478	07458	07437	07417
50	0.17032	16997	16963	16928	16894	16860	50	0.07397	07377	07357	07337	07317	07297
51	16826	16792	16758	16724	16690	16656	51	07277	07257	07237	07217	07197	07178
52	16622	16588	16554	16520	16487	16453	52	07158	07138	07119	07099	07079	07060
53	16419	16386	16352	16319	16285	16252	53	07040	07021	07001	06982	06962	06943
54	16219	16186	16152	16119	16086	16053	54	06923	06904	06885	06865	06846	06827
55	16020	15987	15954	15921	15888	15856	55	06808	06789	06770	06751	06731	06712
56	15823	15790	15758	15725	15692	15660	56	06693	06674	06656	06637	06618	06599
57	15628	15595	15563	15530	15498	15466	57	06580	06561	06543	06524	06505	06487
58	15434	15402	15370	15338	15306	15274	58	06468	06449	06431	06412	06394	06375
59	15242	15210	15178	15146	15115	15083	59	06357	06338	06320	06302	06283	06265

TABLE XXIII. For finding the Latitude by two Altitudes of the Sun.

Half Elapsed Time.

M	4 Hours. 0″	10″	20″	30″	40″	50″	M	5 Hours. 0″	10″	20″	30″	40″	50″
0	0.06247	06229	06211	06192	06174	06156	0	0.01506	01497	01489	01480	01472	01464
1	06138	06120	06102	06084	06066	06048	1	01455	01447	01439	01430	01422	01414
2	06030	06012	05995	05977	05959	05941	2	01406	01398	01390	01381	01373	01365
3	05924	05906	05888	05871	05853	05836	3	01357	01349	01341	01333	01325	01317
4	05818	05801	05783	05766	05748	05731	4	01310	01302	01294	01286	01278	01270
5	05714	05696	05679	05662	05645	05627	5	01263	01255	01247	01240	01232	01224
6	05610	05593	05576	05559	05542	05525	6	01217	01209	01202	01194	01187	01179
7	05508	05491	05474	05457	05440	05423	7	01172	01164	01157	01150	01142	01135
8	05406	05389	05373	05356	05340	05323	8	01128	01120	01113	01106	01099	01091
9	05306	05290	05273	05257	05240	05224	9	01084	01077	01070	01063	01056	01049
10	0.05207	05191	05174	05158	05142	05125	10	0.01042	01035	01028	01021	01014	01007
11	05109	05093	05076	05060	05044	05028	11	01000	00993	00987	00980	00973	00966
12	05012	04996	04980	04964	04948	04932	12	00960	00953	00946	00940	00933	00926
13	04916	04900	04884	04868	04852	04837	13	00920	00913	00907	00900	00894	00887
14	04821	04805	04789	04774	04758	04742	14	00881	00874	00868	00862	00855	00849
15	04727	04711	04696	04681	04665	04649	15	00843	00836	00830	00824	00818	00811
16	04634	04619	04603	04588	04573	04558	16	00805	00799	00793	00787	00781	00775
17	04542	04527	04512	04496	04481	04466	17	00769	00763	00757	00751	00745	00739
18	04451	04436	04421	04406	04391	04376	18	00733	00728	00722	00716	00710	00704
19	04361	04346	04332	04317	04302	04287	19	00699	00693	00687	00682	00676	00670
20	0.04272	04257	04243	04228	04214	04199	20	0.00665	00659	00654	00648	00643	00637
21	04185	04170	04155	04141	04127	04112	21	00632	00626	00621	00616	00610	00605
22	04098	04083	04069	04055	04040	04026	22	00600	00594	00589	00584	00579	00574
23	04012	03998	03983	03969	03955	03941	23	00568	00563	00558	00553	00548	00543
24	03927	03913	03899	03885	03871	03857	24	00538	00533	00528	00523	00518	00513
25	03843	03829	03815	03802	03788	03774	25	00508	00504	00499	00494	00489	00484
26	03760	03746	03733	03719	03706	03692	26	00480	00475	00470	00466	00461	00456
27	03678	03665	03651	03638	03624	03611	27	00452	00447	00443	00438	00434	00429
28	03597	03584	03571	03557	03544	03531	28	00425	00420	00416	00412	00407	00403
29	03517	03504	03491	03478	03465	03452	29	00399	00394	00390	00386	00382	00377
30	0.03438	03425	03412	03399	03386	03373	30	0.00373	00369	00365	00361	00357	00353
31	03360	03348	03335	03322	03309	03296	31	00349	00345	00341	00337	00333	00329
32	03283	03271	03258	03245	03233	03220	32	00325	00321	00317	00313	00310	00306
33	03207	03195	03182	03170	03157	03145	33	00302	00298	00295	00291	00287	00284
34	03132	03120	03107	03095	03083	03070	34	00280	00276	00273	00269	00266	00262
35	03058	03046	03034	03021	03009	02997	35	00259	00255	00252	00249	00245	00242
36	02985	02973	02961	02949	02937	02925	36	00239	00235	00232	00229	00225	00222
37	02913	02901	02889	02877	02865	02853	37	00219	00216	00213	00210	00207	00203
38	02841	02829	02818	02806	02794	02783	38	00200	00197	00194	00191	00188	00185
39	02771	02759	02748	02736	02724	02713	39	00183	00180	00177	00174	00171	00168
40	0.02701	02690	02678	02667	02656	02644	40	0.00166	00163	00160	00157	00155	00152
41	02633	02622	02610	02599	02588	02577	41	00149	00147	00144	00142	00139	00137
42	02565	02554	02543	02532	02521	02510	42	00134	00132	00129	00127	00124	00122
43	02499	02488	02477	02466	02455	02444	43	00120	00117	00115	00113	00110	00108
44	02433	02422	02411	02400	02390	02379	44	00106	00104	00102	00099	00097	00095
45	02368	02357	02347	02336	02326	02315	45	00093	00091	00089	00087	00085	00083
46	02304	02294	02283	02273	02262	02252	46	00081	00079	00077	00075	00074	00072
47	02241	02231	02221	02210	02200	02190	47	00070	00068	00066	00064	00063	00061
48	02179	02169	02159	02149	02139	02128	48	00060	00058	00056	00055	00053	00052
49	02118	02108	02098	02088	02078	02068	49	00050	00049	00047	00046	00044	00043
50	0.02058	02048	02038	02028	02018	02009	50	0.00041	00040	00039	00037	00036	00035
51	01999	01989	01979	01969	01960	01950	51	00033	00032	00031	00030	00029	00028
52	01940	01931	01921	01912	01902	01892	52	00026	00025	00024	00023	00022	00021
53	01883	01873	01864	01854	01845	01836	53	00020	00019	00018	00017	00017	00016
54	01826	01817	01808	01798	01789	01780	54	00015	00014	00013	00013	00012	00011
55	01771	01761	01752	01743	01734	01725	55	00010	00010	00009	00008	00008	00007
56	01716	01707	01698	01689	01680	01671	56	00010	00006	00006	00005	00005	00004
57	01662	01653	01644	01635	01626	01618	57	00004	00003	00003	00003	00002	00002
58	01609	01600	01591	01583	01574	01565	58	00002	00001	00001	00001	00001	00001
59	01557	01548	01540	01531	01523	01514	59	00000	00000	00000	00000	00000	00000

TABLE XXIII. For finding the Latitude by two Altitudes of the Sun.

Middle Time.													
	0 Hours.							1 Hour.					
M	0″	10″	20″	30″	40″	50″	M	0″	10″	20″	30″	40″	50″
0	2.00000	1627[illegible]	46373	63952	76476	86167	0	4.71403	71521	71638	71755	71872	71988
1	2.94053	[illegible]0077	06578	11694	16269	20408	1	72104	72220	72335	72450	72565	72670
2	3.2418[illegible]	27663	30[illegible]82	33[illegible]	36681	39313	2	72793	72907	73020	73133	73246	73358
3	4179[illegible]	44144	46371	48490	50510	52440	3	73470	73582	73694	73805	73916	74027
4	54289	[illegible]	57764	59403	60982	62506	4	74137	74247	74357	74466	74575	74684
5	6397[illegible]	65402	66751	6811[illegible]	69413	70672	5	74792	74900	75008	75116	75223	75330
6	71895	7305[illegible]	74242	75370	76469	77542	6	75437	75544	75650	75756	75862	75967
7	[illegible]	[illegible]	80607	815[illegible]	82537	83471	7	76072	76177	76281	76385	76489	76593
8	84[illegible]	852[illegible]	8615[illegible]	87017	8786[illegible]	88656	8	76697	76800	76903	77006	77108	77210
9	8949[illegible]	902[illegible]	91076	91[illegible]45	92600	93341	9	77312	77413	77514	77615	77716	77817
10	3.94071	94758	95494	9618[illegible]	96872	97545	10	4.77917	78017	78117	78217	78316	78415
11	98207	98860	99503	00136	00761	01376	11	78514	78613	78711	78809	78907	79004
12	4.01983	02581	03172	03754	04329	04896	12	79101	79198	79295	79392	79488	79584
13	05456	06007	06554	07093	07626	08251	13	79680	79776	79871	79966	80061	80156
14	08671	09184	09691	10193	10688	11178	14	80251	8034[illegible]	80439	80533	80627	80720
15	11663	12142	12616	13085	13549	14007	15	80813	80906	80999	81091	81183	81275
16	14461	14911	15355	15796	16231	16663	16	81367	81459	81550	81641	81732	81823
17	17090	17513	17932	18346	18757	19164	17	81914	82004	82094	82184	82274	82364
18	19567	19967	20363	20755	21143	21528	18	82453	82542	82631	82720	82808	82896
19	21910	22289	22664	23036	23405	23770	19	82984	83072	83160	83247	83334	83421
20	4.24133	24493	2484[illegible]	25202	25553	25901	20	4.83508	835[illegible]	83682	83768	83854	83940
21	26246	265[illegible]	26928	27265	27599	27931	21	84026	84111	84196	84281	84366	84451
22	28260	28587	28911	29233	29553	29870	22	84536	84620	84704	84788	84872	84956
23	30185	30497	30807	31115	31421	31725	23	85039	85122	85205	85288	85371	85454
24	32026	32320	32623	32919	33212	33503	24	85536	85618	85700	85782	85864	85945
25	33793	34080	34365	34649	34931	35211	25	86026	86107	86188	86269	86350	86430
26	35489	35765	36040	36313	36584	36853	26	86510	86590	86670	86750	86830	86910
27	37121	37387	37651	37914	38175	38434	27	86989	87068	87147	87226	87304	87382
28	38692	38949	39204	39457	39709	39960	28	87460	87538	87616	87694	87772	87850
29	40209	40457	40702	40947	41190	41432	29	87927	88004	88081	88158	88235	88311
30	4.41673	41912	42150	42386	42622	42856	30	4.88387	88463	88539	88615	88691	88767
31	43088	43320	43550	43779	44007	44233	31	88842	88917	88992	89067	89142	89217
32	44459	44683	44906	45127	45348	45568	32	89291	89365	89439	89513	89587	89661
33	45786	46003	46219	46434	46648	46861	33	89735	89808	89881	89954	90027	90100
34	47073	47284	47494	47702	47910	48117	34	90173	90246	90318	90390	90462	90534
35	48323	48527	48731	48934	49136	49336	35	90606	90678	90750	90821	90892	90963
36	49536	49735	49933	50130	50326	50522	36	91034	91105	91176	91247	91317	91387
37	50716	50910	51102	51294	51485	51675	37	91457	91527	91597	91667	91737	91807
38	51864	52052	52240	52426	52612	52797	38	91876	91945	92014	92083	92152	92221
39	52981	53165	53347	53529	53710	53891	39	92290	92358	92426	92494	92562	92630
40	4.54070	54249	54427	54604	54780	54956	40	4.92698	92766	92834	92901	92968	93035
41	55131	55306	55479	55652	55824	55996	41	93102	93169	93236	93303	93369	93435
42	56166	56336	56506	56674	56842	57010	42	93501	93567	93633	93699	93765	93831
43	57177	57343	57508	57673	57837	58000	43	93897	93962	94027	94092	94157	94222
44	58163	58325	58487	58648	58808	58968	44	94287	94352	94417	94481	94545	94609
45	59127	59285	59443	59600	59751	59913	45	94673	94737	94801	94865	94929	94993
46	60069	60224	60378	60532	60685	60838	46	95056	95119	95182	95245	95308	95371
47	60990	61141	61292	61443	61593	61742	47	95434	95497	95559	95621	95683	95745
48	61891	62039	62187	62334	62481	62627	48	95807	95869	95931	95993	96055	96117
49	62773	62918	63063	63207	63351	63494	49	96178	96239	96300	96361	96422	96483
50	4.63637	63779	63921	64062	64203	64343	50	4.96544	96605	96665	96725	96785	96845
51	64483	64622	64761	64899	65037	65175	51	96906	96966	97026	97086	97145	97204
52	65312	65448	65584	65720	65855	65990	52	97264	97323	97383	97442	97501	97560
53	66125	66259	66392	66525	66659	66790	53	97618	97677	97736	97794	97853	97911
54	66922	67053	67184	67314	67444	67574	54	97969	98027	98085	98143	98201	98259
55	67703	67832	67961	68089	68217	68344	55	98316	98374	98431	98489	98546	98603
56	68471	68597	68723	6884	68974	69099	56	98660	98717	98774	98831	98887	98944
57	69224	69348	69472	69595	69718	69841	57	99000	99057	99113	99169	99225	99281
58	69963	70084	70207	70328	70449	70569	58	99337	99393	9944[illegible]	99504	99559	99615
59	70689	70809	70928	71047	71166	71285	59	99670	99725	99780	99835	99890	99945

Middle Time.

2 Hours.

M	0″	10″	20″	30″	40″	50″	M
0	5.00000	00055	00109	00164	00218	00272	0
1	00327	00381	00435	00489	00543	00596	1
2	00650	00704	00757	00810	00864	00917	2
3	00970	01023	01076	01129	01182	01234	3
4	01287	01339	01392	01444	01496	01549	4
5	01601	01653	01705	01757	01808	01860	5
6	01912	01963	02014	02066	02117	02168	6
7	02219	02270	02321	02372	02423	02473	7
8	02524	02574	02625	02675	02725	02776	8
9	02826	02876	02926	02976	03026	03075	9
10	5.03125	03174	03224	03275	03322	03372	10
11	03421	03470	03519	03568	03617	03665	11
12	03714	03763	03811	03859	03908	03956	12
13	04004	04052	04100	04148	04196	04244	13
14	04292	04340	04387	04435	04482	04530	14
15	04577	04624	04671	04718	04765	04812	15
16	04859	04906	04952	04999	05046	05092	16
17	05139	05185	05231	05278	05324	05370	17
18	05416	05462	05508	05553	05599	05645	18
19	05690	05736	05781	05827	05872	05917	19
20	5.05962	06007	06052	06097	06142	06187	20
21	06232	06276	06321	06365	06410	06454	21
22	06498	06543	06587	06631	06675	07619	22
23	06763	06807	06851	06894	06938	06981	23
24	07025	07068	07112	07155	07198	07241	24
25	07284	07328	07371	07413	07456	07499	25
26	07542	07584	07627	07670	07712	07754	26
27	07797	07839	07881	07923	07965	08007	27
28	08049	08091	08133	08175	08216	08258	28
29	08300	08341	08383	08424	08465	08507	29
30	5.08548	08589	08630	08671	08712	08753	30
31	08794	08834	08875	08916	08956	08997	31
32	09037	09078	09118	09158	09198	09239	32
33	09279	09319	09359	09399	09438	09478	33
34	09518	09558	09597	09637	09676	09716	34
35	09755	19794	09834	09873	09912	09951	35
36	09990	10029	10068	10107	10146	10184	36
37	10223	10262	10300	10339	10377	10416	37
38	10454	10492	10531	10569	10607	10645	38
39	10683	10721	10759	10797	10834	10872	39
40	5.10910	10947	10985	11022	11060	11097	40
41	11135	11172	11209	11246	11283	11320	41
42	11357	11394	11431	11468	11505	11542	42
43	11578	11615	11652	11688	11725	11761	43
44	11797	11834	11870	11906	11942	11979	44
45	12014	12050	12086	12122	12158	12194	45
46	12229	12265	12301	12336	12372	12407	46
47	12443	12478	12513	12549	12584	12619	47
48	12654	12689	12724	12759	12794	12829	48
49	12864	12898	12933	12968	13002	13037	49
50	5.13071	13106	13140	13175	13209	13243	50
51	13277	13311	13345	13379	13413	13447	51
52	13481	13515	13549	13583	13616	13650	52
53	13684	13717	13751	13784	13818	13851	53
54	13884	13917	13951	13984	14017	14050	54
55	14083	14116	14149	14182	14215	14247	55
56	14280	14313	14345	14378	14411	14443	56
57	14475	14508	14540	14573	14605	14637	57
58	14669	14701	14733	14765	14797	14829	58
59	14861	14893	14925	14957	14988	15020	59

3 Hours.

M	0″	10″	20″	30″	40″	50″
0	5.15052	15083	15115	15146	15177	15209
1	15240	15271	15303	15334	15365	15396
2	15427	15458	15489	15520	15551	15582
3	15613	15643	15674	15705	15735	15766
4	15796	15827	15857	15838	15918	15948
5	15979	16009	16039	16069	16099	16129
6	16159	16189	16219	16249	16279	16309
7	16338	16368	16398	16427	16457	16486
8	16516	16545	16575	16604	16633	16662
9	16692	16721	16750	16779	16808	16837
10	5.16866	16895	16924	16953	16982	17010
11	17039	17068	17096	17125	17153	17182
12	17210	17239	17267	17296	17324	17352
13	17380	17408	17437	17465	17493	17521
14	17549	17577	17604	17632	17660	17688
15	17716	17743	17771	17798	17826	17854
16	17881	17908	17936	17963	17990	18018
17	18045	18072	18099	18126	18154	18181
18	18203	18235	18261	18228	18315	18342
19	18369	18395	18422	18449	18475	18502
20	5.18528	18555	18581	18608	18634	18660
21	18687	18713	18739	18765	18791	18818
22	18844	18870	18896	18922	18948	18973
23	18999	19025	19051	19076	19102	19128
24	19153	19179	19204	19230	19255	19281
25	19306	19331	19357	19382	19407	19432
26	19457	19483	19508	19533	19558	19583
27	19608	19632	19657	19682	19707	19732
28	19756	19781	19806	19831	19855	19879
29	19904	19928	19952	19977	20001	20025
30	5.20050	20074	20098	20122	20146	20170
31	20194	20218	20242	20266	20290	20314
32	20338	20362	20385	20409	20433	20456
33	20480	20504	20527	20551	20574	20597
34	20621	20644	20668	20691	20714	20737
35	20760	20784	20807	20830	20853	20876
36	20899	20922	20945	20967	20990	21013
37	21036	21059	21081	21104	21127	21149
38	21172	21194	21217	21239	21261	21284
39	21306	21329	21351	21373	21395	21417
40	5.21439	21462	21484	21506	21528	21550
41	21572	21593	21615	21637	21659	21681
42	21702	21724	21746	21767	21789	21810
43	21832	21853	21875	21896	21918	21939
44	21960	21982	22003	22024	22045	22067
45	22088	22109	22130	22151	22172	22193
46	22214	22235	22255	22276	22297	22318
47	22338	22359	22380	22400	22421	22442
48	22462	22483	22503	22524	22544	22564
49	22585	22605	22625	22645	22666	22686
50	5.22706	22726	22746	22766	22786	22806
51	22826	22846	22866	22886	22906	22925
52	22945	22965	22984	23004	23024	23043
53	23063	23082	23102	23121	23141	23160
54	23180	23199	23218	23238	23257	23276
55	23295	23314	23333	23352	23372	23391
56	23410	23429	23447	23466	23485	23504
57	23523	23542	23560	23579	23598	23616
58	23635	23654	23672	23691	23709	23728
59	23746	23765	23783	23801	23820	23838

Middle Time.													
	4 Hours.							5 Hours.					
M	0″	10″	20″	30″	40″	50″	M	0″	10″	20″	30″	40″	50″
0	5.23856	23874	23892	23911	23929	23947	0	5.28597	28606	28614	28623	28631	28639
1	23965	23983	24001	24019	24037	24055	1	28648	28656	28664	28673	28681	28689
2	24073	24091	24108	24126	24144	24162	2	28697	28705	28713	28722	28730	28738
3	24179	24197	24215	24232	24250	24267	3	28746	28754	28762	28770	28778	28786
4	24285	24302	24320	24337	24355	24372	4	28793	28801	28809	28817	28825	28833
5	24389	24407	24424	24441	24458	24476	5	28840	28848	28856	28863	28871	28879
6	24493	24510	24527	24544	24561	24578	6	28886	28894	28901	28909	28916	28924
7	24595	24612	24629	24646	24663	24680	7	28931	28939	28946	28953	28961	28968
8	24697	24714	24730	24747	24763	24780	8	28975	28983	28990	28997	29004	29012
9	24797	24813	24830	24846	24863	24879	9	29019	29026	29033	29040	29047	29054
10	5.24896	24912	24929	24945	24961	24978	10	5.29061	29068	29075	29082	29089	29096
11	24994	25010	25027	25043	25059	25075	11	29103	29110	29116	29123	29130	29137
12	25091	25107	25123	25139	25155	25171	12	29143	29150	29157	29163	29170	29177
13	25187	25203	25219	25235	25251	25266	13	29183	29190	29196	29203	29209	29216
14	25282	25298	25314	25329	25345	25360	14	29222	29229	29235	29241	29248	29254
15	25376	25392	25407	25423	25438	25454	15	29260	29267	29273	29279	29285	29292
16	25469	25484	25500	25515	25530	25546	16	29298	29304	29310	29316	29322	29328
17	25561	25576	25591	25607	25622	25637	17	29334	29340	29346	29352	29358	29364
18	25652	25667	25682	25697	25712	25727	18	29370	29375	29381	29387	29393	29399
19	25742	25757	25771	25786	25801	25816	19	29404	29410	29416	29421	29427	29433
20	5.25831	25845	25860	25875	25889	25904	20	5.29438	29444	29449	29455	29460	29466
21	25918	25933	25948	25962	25976	25991	21	29471	29477	29482	29487	29493	29498
22	26005	26020	26034	26048	26063	26077	22	29503	29509	29514	29519	29524	29529
23	26091	26105	26120	26134	26148	26162	23	29535	29540	29545	29550	29555	29560
24	26176	26190	26204	26218	26232	26246	24	29565	29570	29575	29580	29585	29590
25	26260	26274	26288	26301	29315	26329	25	29595	29599	29604	29609	29614	29619
26	26343	26357	26370	26384	26397	26411	26	29623	29628	29633	29637	29642	29647
27	26425	26438	26452	26465	26479	26492	27	29651	29656	29660	29665	29669	29674
28	26506	26519	26532	26546	26559	26572	28	29678	29683	29687	29691	29696	29700
29	26586	26599	26612	26625	26638	26651	29	29704	29709	29713	29717	29721	29726
30	5.26665	26678	26691	26704	26717	26730	30	5.29730	29734	29738	29742	29746	29750
31	26743	26755	26768	26781	26794	26807	31	29754	29758	29762	29766	29770	29774
32	26820	26832	26845	26858	26870	26883	32	29778	29782	29786	29790	29793	29797
33	26896	26908	26921	26933	26946	26958	33	29801	29805	29808	29812	29816	29819
34	26971	26983	26996	27008	27020	27033	34	29823	29827	29830	29834	29837	29841
35	27045	27057	27069	27082	27094	27106	35	29844	29848	29851	29854	29858	29861
36	27118	27130	27142	27154	27166	27178	36	29864	29868	29871	29874	29878	29881
37	27190	27202	27214	27226	27238	27250	37	29884	29887	29890	29893	29896	29900
38	27261	27274	27285	27297	27309	27320	38	29903	29906	29909	29912	29915	29918
39	27332	27344	27355	27367	27379	27390	39	29920	29923	29926	29929	29932	29935
40	5.27402	27413	27425	27436	27447	27459	40	5.29937	29940	29943	29946	29948	29951
41	27470	27481	27493	27504	27515	27526	41	29954	29956	29959	29961	29964	29966
42	27538	27549	27560	27571	27582	27593	42	29969	29971	29974	29976	29979	29981
43	27604	27615	27626	27637	27648	27659	43	29983	29986	29988	29990	29993	29995
44	27670	27681	27692	27703	27713	27724	44	29997	29999	30001	30004	30006	30009
45	27735	27746	27756	27767	27777	27788	45	30010	30012	30014	30016	30018	30020
46	27799	27809	27820	27830	27841	27851	46	30022	30024	30026	30028	30029	30031
47	27862	27872	27882	27893	27903	27913	47	30033	30035	30037	30038	30040	30042
48	27924	27934	27944	27954	27964	27975	48	30043	30045	30047	30048	30050	30051
49	27989	27995	28005	28015	28025	28035	49	30053	30054	30056	30057	30059	30060
50	5.28045	28055	28065	28075	28085	28094	50	5.30062	30063	30064	30066	30067	30068
51	28104	28114	28124	28134	28143	28153	51	30070	30071	30072	30073	30074	30075
52	28163	28172	28182	28191	28201	28211	52	30077	30078	30079	30080	30081	30082
53	28220	28230	28239	28249	28258	28267	53	30083	30084	30085	30086	30086	30087
54	28277	28286	28295	28305	28314	28323	54	30088	30089	30090	30090	30091	30092
55	28332	28342	28351	28360	28369	28378	55	30093	30093	30094	30095	30095	30096
56	28387	28396	28405	28414	28423	28432	56	30096	30097	30097	30098	30098	30099
57	28441	28450	28459	28468	28477	28485	57	30099	30100	30100	30100	30101	30101
58	28494	28502	28512	28520	28529	28538	58	30101	30102	30102	30102	30102	30102
59	28546	28555	28563	28572	28580	28589	59	30103	30103	30103	30103	30103	30103

Log Rising.

M	0 Hour. 0″	10″	20″	30″	40″	50″	M	1 Hour. 0″	10″	20″	30″	40″	50″
0	8.00000	42230	02436	37654	62642	02024	0	3.53423	53482	53721	53959	54197	54434
1	97860	11250	22848	33079	42230	50509	1	3.54670	54905	55140	55375	55608	55841
2	9.58066	65019	71455	77448	83054	88319	2	56074	56306	56537	56767	56997	57226
3	93284	67980	02435	06673	10714	14575	3	57455	57683	57910	58137	58363	58589
4	0.18271	21817	25224	28502	31660	34708	4	58814	59038	59262	59486	59708	59930
5	37653	40501	43258	45931	48524	51041	5	60152	60373	60593	60813	61032	61251
6	53488	55868	58184	60440	62639	64784	6	61469	61686	61903	62120	62336	62551
7	66877	68920	70917	72869	74778	76646	7	62766	62980	63194	63407	63620	63832
8	78474	80265	82019	83739	75426	87080	8	64043	64254	64465	64675	64885	65094
9	88703	90297	91862	93399	94907	96394	9	65302	65510	65717	65924	66131	66337
10	1.97854	99289	00699	02091	03458	04805	10	3.66542	66747	66952	67156	67359	67562
11	2.06131	07437	08723	09991	11240	12472	11	67765	67967	68163	68369	68570	68770
12	13687	14885	16066	17223	28382	19517	12	68969	69169	69367	69566	69764	69961
13	20638	21744	22836	23915	24980	26033	13	70157	70354	70550	70745	70940	71135
14	27073	28100	29116	30120	31112	32093	14	71329	71523	71716	71909	72101	72293
15	23063	24023	34972	35916	36839	37758	15	72485	72676	72867	73057	73247	73436
16	28667	29567	40457	41338	42211	43075	16	73625	73813	74001	74189	74376	74563
17	43930	44777	45616	46447	47270	48085	17	74750	74936	75121	75307	75491	75676
18	48893	49693	50486	51271	52050	52821	18	75860	76043	76227	76409	76952	76774
19	53586	54344	55096	55841	56580	57312	19	76955	77137	77318	77498	77678	77858
20	2.58039	58759	59473	60182	60885	61582	20	3.78037	78216	78395	78573	78750	78928
21	62274	62960	63641	64316	64987	65652	21	79105	79282	79458	79634	79809	79985
22	66312	66967	67617	68262	68903	69538	22	80159	80334	80508	80682	80855	81028
23	70169	70796	71418	72036	72649	73258	23	81201	81373	81545	81717	81888	82059
24	73863	74464	75060	75652	76241	76825	24	82230	82400	82570	82739	82908	83077
25	77405	77982	78555	79124	79689	80251	25	83246	83414	83582	83749	83917	84083
26	80809	81363	81914	82461	83005	83546	26	84250	84416	84582	84748	84913	85078
27	84083	84617	85148	85675	86199	86720	27	85242	85406	85570	85734	85897	86060
28	87238	87753	88265	88773	89279	89782	28	86223	86385	86547	86709	86870	87031
29	90282	90779	91273	91765	92254	92740	29	87192	87352	87513	87672	87832	87991
30	2.93223	93703	94181	94656	95129	95599	30	3.88150	88309	88467	88625	88783	88940
31	96067	96532	96994	97454	97912	98367	31	89097	79254	89411	89567	89723	89879
32	98820	99270	99718	00164	00608	01049	32	90034	90189	90344	90498	90653	90807
33	3.01488	01925	02360	02792	03223	03650	33	90960	91114	92167	91420	91572	91724
34	04077	04501	04922	05342	05760	06176	34	91876	92028	92179	92331	92482	92632
35	06590	07001	07411	07819	08225	08630	35	92782	92932	93052	93232	93381	93530
36	09032	09432	09830	10227	10622	11015	36	93679	93827	93975	94123	94271	94418
37	11406	11796	12184	12570	12954	13337	37	94566	94712	94859	95005	95151	95297
38	13718	14097	14475	14850	15225	15597	38	95443	95588	95733	95878	96023	96167
39	15969	16338	16706	17072	17437	17800	39	96311	96455	96599	96742	96885	97028
40	3.18162	18522	18881	19238	19594	19948	40	3.97170	97313	97455	97597	97738	97880
41	20301	20653	21093	21351	21698	22044	41	98021	98162	98302	98442	98583	98723
42	22389	22732	23073	23414	23753	24090	42	98862	99002	99141	99280	99419	99557
43	24427	24762	25095	25428	25759	26089	43	99696	99834	99972	00109	00247	00384
44	26418	26745	27072	27396	27720	28842	44	4.00521	00657	00793	00930	01066	01202
45	28363	28683	29002	29320	29637	29952	45	01337	01473	01608	01743	01877	02012
46	30266	30579	30891	31202	31512	31820	46	02146	02280	02414	02547	02681	02814
47	32128	32434	32739	33044	33347	33649	47	02947	03080	03212	03344	03477	03608
48	33950	34250	34549	34847	35144	35439	48	03740	03871	04003	04134	04265	04395
49	35734	36028	36321	36613	36903	37193	49	04526	04656	04786	04916	05045	05175
50	3.37482	37770	38057	38343	38628	38912	50	4.05304	05433	05561	05690	05818	05946
51	39195	39477	39759	40039	40318	40597	51	06074	06202	06330	06457	06584	06711
52	40875	41151	41247	41702	41976	42250	52	06838	06965	07091	07217	07343	07469
53	42523	42794	43064	43334	43603	43871	53	07595	07720	07845	07970	08095	08220
54	44138	44404	44670	44935	45199	45462	54	08344	08468	08592	08716	08840	08964
55	45724	45986	46247	46507	46765	47024	55	09087	09210	09333	09456	09578	09701
56	47282	47539	47795	48050	48305	48558	56	09823	09945	10067	10188	10310	10431
57	48811	49064	49315	49566	49816	50066	57	10552	10673	10794	10915	11035	11155
58	50314	50562	50809	51056	51301	51547	58	11275	11395	11515	11634	11754	11873
59	3.51791	52035	52278	52520	52761	53002	59	4.11992	12111	12229	12348	12466	12584

Log Rising.

M	2 Hours 0″	10″	20″	30″	40″	50″	M	3 Hours. 0″	10″	20″	30″	40″
0	[illegible]	[illegible]	12938	[illegible]	13172	[illegible]	0	4.46671	46747	46823	46899	46975
1	[illegible]	[illegible]	13640	[illegible]	13872	13958	1	47127	47203	47278	47354	47430
2	[illegible]	14220	[illegible]	[illegible]	14566	14682	2	47580	47656	47731	47806	47881
3	[illegible]	[illegible]	15026	[illegible]	15255	15369	3	48031	48106	48180	48255	48330
4	15483	[illegible]	15710	15824	15937	16050	4	48479	48553	48627	48701	48775
5	16162	[illegible]	[illegible]	16501	16614	16726	5	48924	48998	49071	49145	49219
6	[illegible]	[illegible]	[illegible]	17173	17285	17396	6	49366	49440	49513	[illegible]	49659
7	17507	17618	[illegible]	17839	[illegible]	18060	7	49806	49879	49952	50025	[illegible]
8	18171	18281	18391	18500	18610	18719	8	50243	50316	50388	50461	50533
9	18828	[illegible]	[illegible]	9156	19265	19373	9	50677	50750	50822	50894	50966
10	4.19482	19590	19698	19806	19914	20021	10	4.51109	51181	51253	51325	51396
11	20129	20237	20344	20451	20558	20665	11	51539	51610	51681	51753	51824
12	[illegible]	20878	20984	21091	21197	21303	12	51966	52037	52107	52178	52249
13	[illegible]	21514	21620	21725	21831	21936	13	52390	52461	52531	52601	52672
14	22041	22146	[illegible]	22355	22459	22564	14	52812	52882	52952	53022	53092
15	[illegible]	22772	[illegible]	22980	23083	23187	15	53231	53301	53371	53440	53510
16	[illegible]	3393	23496	23599	23702	23805	16	53648	53718	53787	53856	53925
17	[illegible]	24010	24112	24214	24316	24418	17	54063	54132	54201	54269	54338
18	24520	24622	24723	24825	24926	25027	18	54475	54544	54612	54680	54749
19	[illegible]	[illegible]	25330	25430	25531	25631	19	54885	54953	55021	55089	55157
20	4.25731	[illegible]	5931	26031	26131	26231	20	4.55293	55360	55428	55496	55563
21	26330	26429	26529	26628	26727	26826	21	55698	55765	55832	55900	55967
22	26924	[illegible]	27121	27220	27318	27416	22	56101	56168	56235	56301	56368
23	27514	27612	27710	27807	27905	28002	23	56501	56568	56634	56701	56767
24	28099	[illegible]	28294	28391	28487	28584	24	56900	56966	57032	57098	57164
25	28681	[illegible]	28873	[illegible]	29065	29162	25	57296	57362	57428	57494	57559
26	[illegible]	[illegible]	[illegible]	29544	29639	29735	26	57690	57756	57821	57886	57951
27	29837	[illegible]	30020	30115	30209	30304	27	58082	58147	58212	58277	58342
28	[illegible]	[illegible]	30587	30681	30775	30868	28	58471	58536	58601	58665	58730
29	[illegible]	31056	[illegible]	31243	31337	31430	29	[illegible]	58923	58988	59052	59116
30	[illegible]	31616	31709	31801	31894	[illegible]	30	4.59244	59308	59372	59436	59500
31	32079	32171	[illegible]	32356	[illegible]	32540	31	59627	59691	59755	59818	59882
32	32631	[illegible]	[illegible]	32906	32997	33089	32	[illegible]	60072	60135	60198	60261
33	33180	33271	[illegible]	33453	33543	33634	33	60387	60450	60513	60576	[illegible]
34	33724	33815	33905	33995	34085	[illegible]	34	60764	60827	60890	60952	[illegible]
35	3426	[illegible]	34444	34534	34623	34713	35	[illegible]	60202	61264	61326	[illegible]
36	[illegible]	34891	[illegible]	35069	35158	[illegible]	36	61512	61574	61636	61698	61760
37	35335	35424	35512	35601	35689	[illegible]	37	61883	61945	62006	62068	62129
38	3586	[illegible]	36041	36128	36216	36303	38	62252	62313	62375	62436	[illegible]
39	36391	36478	36564	36653	36740	36827	39	62619	62680	62741	62802	[illegible]
40	4.36913	[illegible]	37087	37173	37260	37346	40	4.62984	63045	63105	63166	63226
41	37432	[illegible]	37604	37690	[illegible]	37862	41	63347	63407	63468	63528	[illegible]
42	[illegible]	38033	38119	38204	38289	38374	42	63708	63768	63828	63888	[illegible]
43	[illegible]	[illegible]	38629	38714	38799	38884	43	64068	64127	[illegible]	64246	[illegible]
44	3896	[illegible]	39137	39231	39305	39389	44	64425	64484	64544	64603	[illegible]
45	39473	[illegible]	39641	39725	39808	39892	45	64782	64839	54898	64957	[illegible]
46	[illegible]	40059	40142	40225	40308	40391	46	65134	65193	65251	65310	[illegible]
47	[illegible]	[illegible]	40639	40722	40804	40886	47	65480	65542	65602	65661	[illegible]
48	40969	[illegible]	41133	41215	41297	41379	48	65836	65895	65952	66010	[illegible]
49	[illegible]	41532	[illegible]	[illegible]	41787	41868	49	66184	66241	66299	66357	[illegible]
50	4.41950	42031	42112	42193	42274	42355	50	4.66530	66588	66645	66702	[illegible]
51	42435	42516	42597	42677	42758	42838	51	66874	66932	[illegible]	67046	[illegible]
52	42918	42998	43078	43158	43238	43318	52	67217	67274	67331	67388	[illegible]
53	43398	43477	43557	43636	43716	43795	53	[illegible]	67615	67671	67728	[illegible]
54	43874	43953	44032	[illegible]	44190	[illegible]	54	[illegible]	67954	68010	68066	[illegible]
55	44348	44426	44505	44583	[illegible]	44740	55	68235	68291	68347	68403	[illegible]
56	44819	44896	44974	[illegible]	[illegible]	45208	56	68571	68627	[illegible]	68738	[illegible]
57	45286	[illegible]	45441	45518	45596	45673	57	68903	68960	69016	69071	[illegible]
58	[illegible]	[illegible]	45904	[illegible]	46058	46125	58	[illegible]	69292	[illegible]	69403	[illegible]
59	4.46812	46289	46365	46442	46518	46595	59	4.69368	69523	69678	69733	[illegible]

Table XXIII. For finding the Latitude by two Altitudes of the Sun.

Log Rising.

	4 Hours.							5 Hours.					
M	0″	10″	20″	30″	40″	50″	M	0″	10″	20″	30″	40″	50″
0	4.69897	69952	70036	70061	70115	70170	0	4.86992	87034	87075	87116	87157	87198
1	70224	70279	70333	70387	70442	70496	1	87239	87280	87321	87362	87402	87443
2	70550	70604	70658	70712	70766	70820	2	87484	87525	87566	87606	87647	87688
3	70874	70928	70982	71036	71089	71143	3	87728	87769	87809	87850	87890	87931
4	71197	71250	71304	71357	71411	71464	4	87971	88012	88052	88093	88133	88173
5	71518	71571	71624	71678	71731	71784	5	88213	88254	88294	88334	88374	88414
6	71837	71890	71943	71996	72049	72102	6	88454	88494	88534	88574	88614	88654
7	72155	72208	72260	72313	72366	72418	7	88694	88734	88774	88814	88853	88893
8	72471	72523	72576	72628	72681	72733	8	88933	88973	89012	89052	89091	89131
9	72785	72838	72890	72942	72994	73046	9	89171	89210	89250	89289	89328	89368
10	4.73098	73150	73202	73254	73306	73358	10	4.89407	89447	89486	89525	89564	89604
11	73410	73462	73514	73565	73617	73668	11	89643	89682	89721	89760	89799	89838
12	73720	73772	73823	73874	73926	73977	12	89877	89916	89955	89994	90033	90072
13	74028	74080	74131	74182	74233	74284	13	90111	90149	90188	90227	90266	90305
14	74335	74386	74437	74488	74539	74590	14	90345	90382	90421	90459	90498	90536
15	74641	74692	74742	74793	74844	74894	15	90575	90613	90652	90690	90728	90767
16	74945	74995	75046	75096	75147	75197	16	9080	90843	90882	90920	90958	90996
17	75247	75297	75348	75398	75448	75498	17	91034	91073	91111	91149	91187	91225
18	75549	75599	75649	75699	75748	75798	18	91263	91301	91339	91377	91415	91452
19	75848	75898	75948	75997	76047	76097	19	91490	91528	91566	91603	91644	91679
20	4.76146	76196	76245	76295	76344	76394	20	4.91716	91754	91792	91830	91867	91904
21	76443	76492	76542	76591	76640	76689	21	91942	91979	92017	92054	92092	92129
22	76738	76787	76836	76885	76934	76983	22	92166	92203	92241	92278	92315	92352
23	77032	77081	77130	77179	77227	77276	23	92390	92427	92464	92501	92538	92575
24	77325	77373	77422	77470	77519	77567	24	92612	92649	92686	92723	92760	92796
25	77616	77664	77713	77761	77809	77857	25	92833	92870	92907	92944	92980	93017
26	77906	77954	78002	78050	78098	78146	26	93054	93090	93127	93164	93200	93237
27	78194	78242	78290	78338	78385	78433	27	93273	93310	93346	93383	93419	93455
28	78481	78528	78576	78624	78671	78719	28	93492	93528	93564	93600	93637	93673
29	78767	78814	78861	78908	78956	79003	29	93709	93745	93781	93817	93854	93890
30	4.79051	79098	79145	79192	79240	79287	30	4.93926	93962	93998	94034	94069	94105
31	79334	79381	79428	79475	79522	79568	31	94141	94177	94213	94249	94284	94320
32	79615	79662	79709	79756	79802	79849	32	94356	94392	94428	94463	94499	94534
33	79895	79942	79989	80035	80082	80128	33	94570	94605	94641	94676	94712	94747
34	80175	80221	80267	80314	80360	80406	34	94782	94818	94853	94888	94624	94959
35	80452	80498	80544	80591	80637	80683	35	94994	95029	95065	95100	95135	95170
36	80729	80775	80820	80866	80912	80958	36	95205	95240	95275	95310	95345	95380
37	81004	81049	81095	81141	81186	81232	37	95415	95450	95485	95520	95555	95589
38	81277	81323	81368	81414	81459	81505	38	95624	95659	95694	95728	95763	95798
39	81505	81595	81641	81686	81731	81776	39	95832	95867	95902	95936	95971	96005
40	4.81821	81866	81911	81956	82001	82046	40	4.96040	96074	96109	96143	96177	96212
41	82091	82136	82181	82226	82271	82315	41	96246	96280	96315	96349	96383	96417
42	82360	82405	82449	82494	82538	82583	42	96451	96486	96520	96554	96588	96622
43	82627	82672	82716	82761	82805	82850	43	96656	96690	96724	96758	96792	96826
44	82894	82938	82982	83026	83071	83115	44	96860	96894	96927	96961	96995	97029
45	83159	83203	83247	83291	83335	83379	45	97062	97096	97130	97163	97197	97231
46	83423	83467	83510	83554	83598	83642	46	97264	97293	97331	97365	97398	97432
47	83685	83729	83773	83816	83860	83903	47	97465	97499	97532	97566	97599	97632
48	83947	83990	84034	84077	84120	84164	48	97665	97699	97732	97765	97798	97832
49	84207	84250	84293	84337	84380	84423	49	97865	97898	97931	97964	97997	98030
50	4.84466	84509	84552	84595	84638	84681	50	4.98063	98096	98129	98162	98195	98228
51	84724	84767	84810	84852	84895	84938	51	98261	98293	98326	98359	98392	98425
52	84981	85023	85066	85108	85151	85193	52	98457	98490	98523	98555	98588	98620
53	85236	85278	85321	85363	85406	85448	53	98653	98686	98718	98751	98783	98816
54	85490	85533	85575	85617	85659	85701	54	98848	98880	98913	98945	98978	99010
55	85744	85786	85828	85870	85912	85954	55	99042	99074	99107	99139	99171	99203
56	85996	86037	86079	86121	86163	86205	56	99235	99267	99300	99332	99364	99396
57	86246	86288	86330	86372	86413	86455	57	99428	99460	99492	99524	99556	99587
58	86496	86538	86579	86621	86662	86704	58	99619	99651	99683	99715	99747	99778
59	86745	86786	86828	86869	86910	86957	59	99810	99842	99873	99905	99937	99968

Half Elapsed Time.

M	2 Hours. 0″	10′	20″	30″	40″	50″	M	3 Hours. 0″	10″	20″	30″	40″	50″
0	0.30103	30048	29994	29939	29885	29831	0	0.15051	15020	14988	14957	14926	14894
1	29776	29721	29668	29614	29560	29507	1	14863	14832	14800	14769	14738	14707
2	29453	29399	29346	29293	29239	29186	2	14676	14645	14614	14583	14552	14521
3	29133	29080	29027	28974	28921	28869	3	14490	14460	14429	14398	14368	14337
4	28816	28764	28711	28659	28607	28554	4	14307	14276	14246	14215	14185	14155
5	28502	28450	28398	28346	28295	28243	5	14124	14094	14064	14034	14004	13974
6	28191	28140	28089	28037	27986	27935	6	13944	13914	13884	13854	13824	13794
7	27884	27833	27782	27731	27680	27630	7	13765	13735	13705	13676	13646	13617
8	27579	27529	27478	27428	27378	27327	8	13587	13558	13528	13499	13470	13441
9	27277	27227	27177	27127	27077	27028	9	13411	13382	13353	13324	13295	13266
10	0.26978	26929	26879	26830	26781	26731	10	0.13237	13208	13179	13150	13121	13093
11	26682	26633	26584	26535	26486	26438	11	13064	13035	13007	12978	12950	12921
12	26389	26340	26292	26244	26195	26147	12	12893	12864	12836	12807	12779	12751
13	26099	26051	26003	25955	25907	25859	13	12723	12695	12666	12638	12610	12582
14	25811	25763	25716	25668	25621	25573	14	12554	12526	12499	12471	12443	12415
15	25526	25479	25432	25385	25338	25291	15	12387	12360	12332	12304	12277	12249
16	25244	25197	25150	25104	25057	25011	16	12222	12195	12167	12140	12112	12085
17	24964	24918	24872	24825	24779	24733	17	12058	12031	12004	11977	11949	11922
18	24687	24641	24595	24550	24504	24458	18	11895	11868	11842	11815	11788	11761
19	24413	24367	24322	24276	24231	24186	19	11734	11708	11681	11654	11628	11601
20	0.24141	24096	24051	24006	23961	23916	20	0.11575	11548	11522	11495	11469	11443
21	23871	23827	23782	23738	23693	23649	21	11416	11390	11364	11333	11312	11285
22	23605	23560	23516	23472	23428	23384	22	11259	11233	11207	11181	11155	11130
23	23340	23296	23252	23209	23165	23122	23	11104	11078	11052	11027	11001	10975
24	23078	23035	22991	22948	22905	22862	24	10950	10924	10899	10873	10848	10822
25	22819	22775	22732	22690	22647	22604	25	10797	10772	10746	10721	10696	10671
26	22561	22519	22476	22433	22391	22349	26	10646	10620	10595	10570	10545	10520
27	22306	22264	22222	22180	22138	22096	27	10495	10471	10446	10421	10396	10371
28	22054	22012	21970	21928	21887	21845	28	10347	10322	10297	10272	10248	10224
29	21803	21762	21720	21679	21638	21596	29	10199	10175	10151	10126	10102	10078
30	0.21555	21514	21473	21432	21391	21350	30	0.10053	10029	10005	09981	09957	09933
31	21309	21268	21228	21187	21147	21106	31	09909	09885	09861	09837	09813	09789
32	21066	21025	20985	20945	20905	20864	32	09765	09741	09718	09694	09670	09647
33	20824	20784	20744	20704	20665	20625	33	09623	09599	09576	09552	09529	09506
34	20585	20545	20506	20466	20427	20387	34	09482	09459	09435	09412	09389	09366
35	20348	20309	20269	20230	20191	20152	35	09343	09319	09296	09273	09250	09227
36	20113	20074	20035	19996	19957	19919	36	09204	09181	09158	09136	09113	09090
37	19880	19841	19803	19764	19726	19687	37	09067	09044	09022	08999	08976	08954
38	19649	19611	19572	19534	19496	19458	38	08931	08909	08886	08864	08842	08819
39	19420	19382	19344	19306	19269	19231	39	08797	08774	08752	08730	08708	08686
40	0.19193	19156	19118	19081	19043	19006	40	0.08664	08641	08619	08597	08575	08553
41	18968	18931	18894	18857	18820	18783	41	08531	08510	08488	08466	08444	08422
42	18746	18709	18672	18635	18598	18561	42	08401	08379	08357	08336	08314	08293
43	18525	18488	18451	18415	18378	18342	43	08271	08250	08228	08207	08185	08164
44	18306	18269	18233	18197	18161	18124	44	08143	08121	08100	08079	08058	08036
45	18089	18053	18017	17981	17945	17909	45	08015	07994	07973	07952	07931	07910
46	17874	17838	17802	17767	17731	17696	46	07889	07868	07848	07827	07806	07785
47	17660	17625	17590	17554	17519	17484	47	07765	07744	07723	07703	07682	07661
48	17449	17414	17379	17344	17309	17274	48	07641	07620	07600	07579	07559	07539
49	17239	17205	17170	17135	17101	17066	49	07518	07498	07478	07458	07437	07417
50	0.17032	16997	16963	16928	16894	16860	50	0.07397	07377	07357	07337	07317	07297
51	16826	16792	16758	16724	16690	16656	51	07277	07257	07237	07217	07197	07178
52	16622	16588	16554	16520	16487	16453	52	07158	07138	07119	07099	07079	07060
53	16419	16386	16352	16319	16285	16252	53	07040	07021	07001	06982	06962	06943
54	16219	16186	16152	16119	16086	16053	54	06923	06904	06885	06865	06846	06827
55	16020	15987	15954	15921	15888	15856	55	06808	06789	06770	06751	06731	06712
56	15823	15790	15758	15725	15692	15660	56	06693	06674	06656	06637	06618	06599
57	15628	15595	15563	15530	15498	15466	57	06580	06561	06543	06524	06505	06487
58	15434	15402	15370	15338	15306	15274	58	06468	06449	06431	06412	06394	06375
59	15242	15210	15178	15146	15115	71083	59	06357	06338	06320	06301	06283	06265

TABLE XXIII. For finding the Latitude by two Altitudes of the Sun.

Half Elapsed Time.

M	4 Hours. 0″	10″	20″	30″	40″	50″	M	5 Hours. 0″	10″	20″	30″	40″	50″
0	0.06247	06229	06211	06192	06174	06156	0	0.01506	0149[illegible]	01489	01480	01472	01464
1	06138	06120	06102	06084	06066	06048	1	01455	01447	01439	01430	01422	01414
2	06030	06012	05995	05977	05959	05941	2	01406	01398	01390	01381	01373	01365
3	05924	05906	05888	05871	05853	05836	3	01357	01349	01341	01333	01325	01317
4	05818	05801	05783	05766	05748	05731	4	01310	01302	01294	01286	01278	01270
5	05714	05696	05679	05662	05645	05627	5	01263	01255	01247	01240	01232	01224
6	05610	05593	05576	05559	05542	05525	6	01217	01209	01202	01194	01187	01179
7	05508	05491	05474	05457	05440	05423	7	01172	01164	01157	0115[illegible]	01142	01135
8	05406	05389	05373	05356	05340	05323	8	01128	01120	01113	01106	01099	01091
9	05306	052[illegible]0	05273	05257	05240	0522[illegible]	9	01084	01077	01070	0106[illegible]	01056	01049
10	0.05207	0519[illegible]	05174	0515[illegible]	05142	05125	10	0.01042	01035	01028	[illegible]1021	01014	01007
11	05109	05093	05076	0506[illegible]	05044	0502[illegible]	11	01000	00993	00987	00980	00973	00966
12	05012	04996	04980	04964	04948	04932	12	00960	00953	00946	00940	00933	00926
13	0491[illegible]	04[illegible]00	04884	04868	04852	04837	13	00920	00913	00907	00900	00894	00887
14	04821	04805	04789	04774	04758	0474[illegible]	14	00881	00874	00868	00862	00855	00849
15	04727	04711	04696	0468[illegible]	04665	04649	15	00843	00836	0[illegible]830	00824	00818	00811
16	04634	04619	04604	04588	04573	0455[illegible]	16	00805	00799	00793	00787	00781	00775
17	04542	04527	04512	04496	04481	04466	17	00769	00763	00757	00751	00745	00739
18	04451	04436	04421	04406	04391	04376	18	00733	00728	00722	00716	00710	00704
19	04361	04346	04332	04317	04302	04287	19	00699	00693	00687	00682	00676	00670
20	0.04272	0425[illegible]	04243	04228	04214	04199	20	0.00665	00659	00654	00648	00643	00637
21	04185	04170	04155	04141	04127	04112	21	00632	00626	00621	00616	00610	00605
22	04098	04083	04069	04055	04040	04026	22	00600	00594	00589	00584	00579	00574
23	04012	03997	03983	03969	03955	03941	23	00563	00563	00558	00553	00548	00543
24	03927	03913	03899	03885	03871	03857	24	00538	00533	00528	00523	00518	00513
25	03843	03829	03815	03802	03788	03774	25	00508	00504	00499	00494	00489	00484
26	03760	03746	03733	03719	03706	03692	26	00480	00475	00470	00466	00461	00456
27	03678	03665	03651	03638	03624	03611	27	00452	00447	00443	00438	00434	00429
28	03597	03584	03571	03557	03544	03531	28	00425	00420	00416	00412	00407	00403
29	03517	03504	03491	03478	03465	03452	29	00399	00394	00390	00386	00382	00377
30	0.03438	03425	03412	03399	03386	03373	30	0.00373	00369	00365	00361	00357	00353
31	03360	03348	03335	03322	03309	03296	31	00349	00345	00341	00337	00333	00329
32	03283	03271	03258	03245	03233	03220	32	00325	00321	00317	0031[illegible]	00310	00306
33	03207	03195	03182	03170	03157	03145	33	00302	00298	[illegible]0295	00291	00287	00284
34	03132	03120	03107	03095	03083	03070	34	00280	00276	00273	00269	00266	00262
35	03058	03046	03034	03021	03009	02997	35	00259	00255	00252	00249	00245	00242
36	02985	02973	02961	02949	02937	02925	36	00239	00235	00232	00229	00225	00222
37	02913	02901	02889	02877	02865	02853	37	00219	00216	00213	00210	00207	00203
38	02841	02829	02818	02806	02794	02[illegible]83	38	00200	00197	00194	00191	00188	00185
39	02771	02759	02748	02736	02724	02713	39	00183	00180	00177	00174	0017[illegible]	00168
40	0.02701	02690	02678	02667	02656	02644	40	0.00166	00163	00160	00157	00155	00152
41	02633	02622	02610	02599	02588	02577	41	00149	00147	00144	00142	00139	00137
42	02565	02554	02543	02532	02521	02510	42	00134	00132	00129	00127	00124	00122
43	02499	02488	02477	02466	02455	02444	43	00120	00117	00115	00113	00110	00108
44	02433	02422	02411	02400	02390	02379	44	00106	00104	00102	00099	00097	00095
45	02368	02357	02347	02336	02326	02315	45	00093	00091	00089	00087	00085	00083
46	02304	02294	02283	02273	02262	02252	46	00081	00079	00077	00075	00074	00072
47	02241	02231	02221	02210	02200	02190	47	00070	00068	00066	0006[illegible]	00063	00061
48	02179	02169	0215[illegible]	02149	02139	02128	48	00060	00058	00056	00055	00053	00052
49	02118	02108	02098	02088	02078	02068	49	00050	00049	00047	00046	0004[illegible]	00043
50	0.02058	02048	02038	02028	02018	02009	50	0.00041	00040	00039	00037	00036	00035
51	01999	01989	01979	01969	01960	01950	51	00033	00032	00031	00030	0002[illegible]	00028
52	01940	01331	01[illegible]21	01912	01902	01892	52	00026	00025	00024	00023	00022	00021
53	01883	01873	01864	01854	01845	01836	53	00020	00019	00018	00017	00017	00016
54	01826	01817	01808	01798	01789	01780	54	00015	00014	00013	00013	00012	00011
55	01771	01761	01752	01743	01734	01725	55	00010	00010	00009	00008	00008	00007
56	01716	01707	01698	01689	01680	01671	56	00010	00006	00006	00005	0000[illegible]	00004
57	01662	01653	01644	01635	01626	01618	57	00004	00003	00003	00003	00002	00002
58	01609	01600	01591	01583	01574	01565	58	00002	00001	00001	00001	00001	00001
59	01557	01548	01540	01531	01523	01514	59	00000	00000	00000	00000	00000	00000

TABLE XXI.

For Finding the Diſtance of Terreſtrial Objects at Sea.

Ht Ft.	Diſt. M.	Diſt. D.	Ht. Ft.	Diſt. M.	Diſt. D.	Ht. Ft.	Diſt. M.	Diſt. D.	Ht. Ft.	Diſt. M.	Diſt. D.
1	1.	32	44	8.	78	320	23.	67	1000	41.	8
2	1.	87	45	8.	87	330	24.	03	1100	43.	9
3	2.	29	46	8.	97	340	24.	39	1200	45.	8
4	2.	65	47	9.	07	350	24.	75	1300	47.	[illegible]
5	2.	96	48	9.	17	360	25.	10	1400	49.	[illegible]
6	3.	24	49	9.	26	370	25.	45	1500	51.	2
7	3.	50	50	9.	35	380	25.	79	1600	52.	9
8	3.	74	55	9.	81	390	26.	13	1700	54.	5
9	3.	97	60	10.	25	400	26.	46	1800	56.	1
10	4.	18	65	10.	67	410	26.	79	1900	57.	7
11	4.	39	70	11.	07	420	27.	11	2000	59.	2
12	4.	58	75	11.	46	430	27.	43	2100	60.	6
13	4.	77	80	11.	83	440	27.	75	2200	62.	1
14	4.	95	85	12.	20	450	28.	06	2300	63.	4
15	5.	12	90	12.	55	460	28.	37	2400	64.	8
16	5.	29	95	13.	89	470	28.	68	2500	66.	1
17	5.	45	100	13.	23	480	28.	98	2600	67.	5
18	5.	61	105	13.	56	490	29.	29	2700	68.	7
19	5.	77	110	13.	88	500	29.	58	2800	70.	0
20	5.	92	115	14.	19	520	30.	17	2900	71.	2
21	6.	06	120	14.	49	540	30.	74	3000	72.	5
22	6.	21	125	14.	79	560	31.	31	3100	73.	7
23	6.	34	130	15.	08	580	31.	86	3200	74.	8
24	6.	48	135	15.	37	600	32.	41	3300	76.	0
25	6.	61	140	15.	65	620	32.	94	3400	77.	1
26	6.	75	145	15.	93	640	33.	47	3500	78.	3
27	6.	87	150	16.	20	660	33.	99	3600	79.	4
28	7.	00	160	16.	73	680	34.	50	3700	80.	5
29	7.	12	170	17.	25	700	35.	00	3800	81.	6
30	7.	25	180	17.	75	720	35.	50	3900	82.	6
31	7.	37	190	18.	24	740	35.	99	4000	83.	7
32	7.	48	200	18.	71	760	36.	47	4100	84.	7
33	7.	60	210	19.	17	780	36.	95	4200	85.	7
34	7.	71	220	19.	62	800	37.	42	4300	86.	8
35	7.	83	230	20.	06	820	37.	88	4400	87.	8
36	7.	94	240	20.	50	840	38.	34	4500	88.	7
37	8.	05	250	20.	92	860	38.	80	4600	89.	7
38	8.	16	260	21.	33	880	39.	25	4700	90.	7
39	8.	26	270	21.	74	900	39.	69	4800	91.	7
40	8.	37	280	22.	14	920	40.	13	4900	92.	6
41	8.	47	290	22.	53	940	40.	56	5000	93.	5
42	8.	57	300	22.	91	960	40.	99	1 M.	96.	1
43	8.	68	310	23.	29	980	41.	42			

TABLE XXII.

Proportion of Powder for Sea Guns.

Pdrs.	Proof. lb. oz.	Service. lb. oz.	Saluting. lb. oz.	Scaling. lb. oz.
42	25. 0	14. 0	10. 0	3. 0
32	21. 0	10. 11	8. 0	2. 12
24	18. 0	8. 0	6. 0	2. 0
18	15. 0	6. 0	4. 8	1. 8
12	12. 0	4. 0	3. 0	1. 0
9	9. 0	3. 0	2. 4	0. 12
6	6. 0	2. 0	2. 0	0. 8
4	4. 0	1. 5	1. 5	0. 6
3	3. 0	1. 0	1. 0	0. 4
$\frac{1}{2}$	0. 8	0. 3	0. 3	0. 1
Caronades.				
42	9. 0	4. 8	4. 8	1. 8
32	8. 0	4. 0	4. 0	1. 4
24	6. 0	3. 0	3. 0	1. 0
18	4. 0	2. 0	2. 0	1. 0
12	3. 0	1. 8	1. 8	0. 12
Wall Pieces.				
	2. 8	0. 10		
Musquets.				
	0. 12	0. 6		
Piſtols.				
	0. 6	0. 3		

N. B These proportions are with powder in good condition; if it is damp, or damaged, a greater quantity will be neceſſary.

A TABLE of the Number and ſorts of Shot contained in the Grapes for the nature of Guns undermentioned.

Pdrs.	Shot.	No. in each.	No. in each box
42	4lb.	9	4
32	3	9	4
24	2	9	6
18	$1\frac{1}{2}$	9	8
12	1	9	10
	Oz.		
9	13	9	12
6	8	9	20
4	6	9	20

Half elapsed Time.

0 Hour.

M.	0″	10″	20″	30″	40″	50″
0		13833	83730	66121	53627	43936
1	2.36018	29324	23525	18409	13834	09695
2	05916	02440	99221	96225	93422	90790
3	1.88307	85959	83732	81613	79593	77663
4	75814	74042	72339	70700	69121	67597
5	66125	64701	63322	61986	60690	59431
6	58208	57018	55861	54733	53634	52561
7	51515	50494	59496	48520	47566	46632
8	45718	44823	43946	43086	42243	41417
9	40605	39809	39027	36258	37503	36762
10	1.36032	35313	34609	33915	33231	32557
11	31896	31243	30600	29967	29342	28727
12	28120	27522	26931	26349	25774	25207
13	24647	24095	23549	23010	22477	21952
14	21432	20919	20412	19910	19415	18925
15	18440	17961	17487	17018	16554	16096
16	15642	15192	14748	14307	13872	13440
17	13013	12590	12171	11757	11346	10939
18	10536	10136	09740	09348	08960	08574
19	08193	07814	07439	07067	06698	06333
20	1.05970	05610	05254	04901	04550	04202
21	03857	03515	03175	02838	02504	02172
22	01843	01516	01192	00870	00550	00233
23	0.99918	99606	99296	98938	98682	98378
24	98077	97777	97480	97184	96891	96600
25	96310	96023	95738	95454	95172	94892
26	94614	94337	94063	93790	93519	93250
27	92982	92716	92452	92189	91928	91669
28	91411	94154	90899	90646	90394	90143
29	89894	89647	89401	89156	88913	88671
30	0.88430	88191	87953	87717	87482	87247
31	87015	86783	86553	86324	86096	85870
32	85644	85420	85197	84976	84755	84535
33	84317	84100	83884	83669	83455	83242
34	83030	82819	82609	82401	82193	81986
35	81780	81576	81372	81169	80967	80767
36	80567	80368	80170	79973	79777	79581
37	79387	79193	79001	78809	78618	78428
38	78239	78051	77863	77677	77491	77306
39	77122	76938	76756	76574	76393	76212
40	0.76033	75854	75676	75499	75323	75147
41	74972	74797	74624	74451	74279	74107
42	73937	73767	73597	73429	73261	73093
43	72926	72760	72595	72430	72266	72103
44	71940	71778	71616	71455	71295	71135
45	70976	70818	70660	70503	70346	70190
46	70034	69879	69725	69571	69418	69265
47	69113	68962	68811	68660	68510	68361
48	68212	68064	67916	67769	67622	67476
49	67330	67185	67040	66896	66752	66609
50	0.66466	66324	66182	66041	65900	65760
51	65620	65481	65342	65204	65066	64928
52	64791	64655	64519	64383	64248	64113
53	63978	63844	63711	63578	63445	63313
54	63181	63050	62919	62789	62659	62529
55	62400	62271	62142	62014	61886	61759
56	61632	61506	61380	61254	61129	61004
57	60879	60755	60631	60508	60385	60262
58	60140	60018	59896	59775	59654	59534
59	59414	59294	59175	59056	58937	58818

1 Hour.

M.	0″	10″	20″	30″	40″	50″
0	0.58700	58582	58465	58348	58231	58115
1	57999	57883	57768	57653	57538	57424
2	57310	57196	57083	56970	56857	56745
3	56633	56521	56409	56298	56187	56076
4	55966	55856	55746	55637	55528	55419
5	55311	55203	55095	54987	54880	54773
6	54666	54559	54453	54347	54241	54136
7	54031	53926	53822	53718	43614	53510
8	53406	53303	53200	53097	52995	52893
9	52791	52690	52589	52488	52387	52286
10	0.52186	52086	51986	51886	51787	51688
11	51589	51490	51392	51294	51196	51099
12	51002	50905	50809	50711	50615	50519
13	50423	50327	50232	50137	50042	49947
14	49852	49758	49664	49570	49476	49383
15	49290	49197	49104	49012	48920	48828
16	48736	48644	48553	48462	48371	48280
17	48189	48099	48009	47919	47829	47739
18	47650	47561	47472	47382	47295	47207
19	47119	47031	46943	46856	46769	46682
20	0.46595	46508	46421	46335	46249	46163
21	46077	45992	45907	45822	45737	45652
22	45567	45583	45399	45315	45231	45147
23	45064	44981	44898	44815	44732	44649
24	44567	44485	44403	44321	44239	44158
25	44077	43996	43915	43834	43753	43673
26	43593	43513	43433	43353	43273	43193
27	43114	43035	42956	42877	42799	42721
28	42643	42565	42487	42409	42331	42253
29	42176	42099	42022	41945	41868	41792
30	0.41716	41640	41564	41488	41412	41336
31	41261	41186	41111	41036	40961	40886
32	40812	40738	40664	40590	40516	40442
33	40368	40295	40222	40149	40076	40003
34	39930	39857	39785	39713	39641	39569
35	39497	39425	39353	39282	39211	39140
36	39069	38998	38927	38856	38786	38716
37	38646	38576	38506	38436	38366	38296
38	38227	38158	38089	38020	37951	37882
39	37813	37745	37677	37609	37541	37473
40	0.37405	37337	37269	37202	37135	37068
41	37001	36934	36867	36800	36734	36668
42	36602	36536	36470	36404	36338	36272
43	36206	36141	36076	36011	35946	35881
44	35816	35752	35686	35622	35558	35494
45	35430	35366	35302	35238	35174	35110
46	35047	34984	34921	34858	34795	34732
47	34669	34606	34544	34482	34420	34358
48	34296	34234	34172	34110	34048	33986
49	33925	33864	33803	33742	33681	33620
50	0.33559	33498	33438	33378	33318	33258
51	33197	33137	33077	33017	32957	32899
52	32839	32780	32720	32661	32602	32543
53	32484	32426	32367	32309	32250	32192
54	32134	32076	32018	31960	31902	31844
55	31787	31729	31672	31614	31557	31500
56	31443	31386	31329	31272	31216	31159
57	31103	31046	30990	30934	30878	30822
58	30766	30710	30655	30599	30544	30488
59	30433	30378	30323	30268	30213	30158

TABLE XXIII. For finding the Latitude by two Altitudes of the Sun.

Half Elapsed Time

M	2 Hours.						M	3 Hours.					
	0″	10′	20″	30″	40″	50″		0″	10″	20″	30″	40″	50″
0	0.30103	30048	29994	29939	29885	29831	0	0.15051	15020	14988	14957	14926	14894
1	29776	29721	29668	29614	29560	29507	1	14863	14832	14800	14769	14738	14707
2	29453	29399	29346	29293	29239	29186	2	14676	14645	14614	14583	14552	14521
3	29133	29080	29027	28974	28921	28869	3	14490	14460	14429	14398	14368	14337
4	28816	28764	28711	28659	28607	28554	4	14307	14276	14246	14215	14185	14155
5	28502	28450	28398	28346	28295	28243	5	14124	14094	14064	14034	14004	13974
6	28191	28140	28089	28037	27986	27935	6	13944	13914	13884	13854	13824	13794
7	27884	27833	27782	27731	27680	27630	7	13765	13735	13705	13676	13646	13617
8	27579	27529	27478	27428	27378	27327	8	13587	13558	13528	13499	13470	13441
9	27277	27227	27177	27127	27077	27028	9	13411	13382	13353	13324	13295	13266
10	0.26978	26929	26879	26830	26781	26731	10	0.13237	13208	13179	13150	13121	13093
11	26682	26633	26584	26535	26486	26438	11	13064	13035	13007	12978	12950	12921
12	26389	26340	26292	26244	26195	26147	12	12893	12864	12836	12807	12779	12751
13	26099	26051	26003	25955	25907	25859	13	12723	12695	12666	12638	12610	12582
14	25811	25763	25716	25668	25621	25573	14	12554	12526	12499	12471	12443	12415
15	25526	25479	25432	25385	25338	2529	15	12387	12360	12332	12305	12277	12249
16	25244	25197	25150	25104	25057	25011	16	12222	12195	12167	12140	12113	12085
17	24964	24918	24872	2482	24779	24733	17	12058	12031	12004	11977	11949	11922
18	24687	2464	24595	24550	24504	24458	18	11895	11868	11842	11815	11788	11761
19	24413	2436	24322	24276	24231	24186	19	11734	11708	11681	11654	11628	11601
20	0.24141	24096	24051	24006	23961	23916	20	0.11575	11548	11522	11495	11469	11443
21	23871	23827	23782	23738	23693	23649	21	1141	11390	11364	11333	11312	11285
22	23605	23560	23516	23472	23428	23384	22	11259	11233	11207	11181	11155	11130
23	23340	23296	23252	23209	23165	23122	23	11104	11078	11052	11027	11001	10975
24	23078	23035	22991	22948	22905	22862	24	10950	10924	10899	10873	10848	10822
25	22819	22775	22732	22690	22647	22604	25	10797	10772	10746	10721	10696	10671
26	22561	22519	22476	22433	22391	22349	26	10646	10620	10595	10570	10545	10520
27	22306	22264	22222	22180	22138	22096	27	10495	10471	10446	10421	10396	10371
28	22054	22012	21970	21928	21887	21845	28	10347	1032	10297	10272	10248	10224
29	21803	21762	21720	21679	21638	21596	29	10199	10175	10151	10126	10102	10078
30	0.21555	2151	21473	21432	21391	21350	30	0.10053	10029	10005	09981	09957	09933
31	21309	21268	21228	21187	21147	21106	31	09909	09885	09861	09837	09813	09789
32	21066	21025	20985	20945	20905	20864	32	09765	09741	09718	09694	09670	09647
33	20824	20784	20744	20704	20665	20625	33	09623	09599	09576	09552	09529	09506
34	20585	20545	20506	20466	20427	20387	34	09482	09459	09435	09412	09389	09366
35	20348	20309	20269	20230	20191	20152	35	09343	09319	09296	09273	09250	09227
36	20113	20074	20035	19996	19957	19919	36	09204	09181	09158	09136	09113	09090
37	19880	19841	19803	19764	19726	19687	37	09067	09044	09022	08999	08976	08954
38	19649	19611	19572	19534	19496	19458	38	08931	08909	08886	08864	08842	08819
39	19420	19382	19344	19306	19269	19231	39	08797	08774	08752	08730	08708	08686
40	0.19193	19156	19118	19081	19043	19006	40	0.08664	08641	08619	08597	08575	08553
41	18968	18931	18894	18857	18820	18783	41	08531	08510	08488	08466	08444	08422
42	18746	18709	18672	18635	18598	18561	42	08401	08379	08357	08336	08314	08293
43	18525	18488	18451	18415	18378	18342	43	08271	08250	08228	08207	08185	08164
44	18306	18269	18233	18197	18161	18124	44	08143	08121	08100	08079	08058	08036
45	18089	18053	18017	17981	17945	17909	45	08015	07994	07973	07952	07931	07910
46	17874	17838	17802	17767	17731	17696	46	07889	07868	07848	07827	07806	07785
47	17660	17625	17590	17554	17519	17484	47	07765	07744	07723	07703	07682	07661
48	17449	17414	17379	17344	17309	17274	48	07641	07620	07600	07579	07559	07539
49	17239	17204	17170	17135	17101	17066	49	07518	07498	07478	07458	07437	07417
50	0.17032	16997	16963	16928	16894	16860	50	0.07397	07377	07357	07337	07317	07297
51	16826	16792	16758	16724	16690	16656	51	07277	07257	07237	07217	07197	07178
52	16622	16588	16554	16520	16487	16453	52	07158	07138	07119	07099	07079	07060
53	16419	16386	16352	16319	16285	16252	53	07040	07021	07001	06982	06962	06943
54	16219	16186	16152	16119	16086	16053	54	06923	06904	06885	06865	06846	06827
55	16020	15987	15954	15921	15888	15856	55	06808	06789	06770	06751	06731	06712
56	15823	15790	15758	15725	15692	15660	56	06693	06674	06656	06637	06618	06599
57	15628	15595	15563	15530	15498	15466	57	06580	06561	06543	06524	06505	06487
58	15434	15402	15370	15338	15306	15274	58	06468	06449	06431	06412	06394	06375
59	15242	15210	15178	15146	15115	71083	59	06357	06338	06320	06301	06283	06265

Half Elapsed Time.

M	4 Hours. 0″	10″	20″	30″	40″	50″	M	5 Hours. 0″	10″	20″	30″	40″	50″
0	0.06247	06229	06211	06192	06174	06156	0	0.01506	01497	01489	01480	01472	01464
1	06138	06120	06102	06084	06066	06048	1	01455	01447	01439	01430	01422	01414
2	06030	06012	05995	05977	05959	05941	2	01406	01398	01390	01381	01373	01365
3	05924	05906	05888	05871	05853	05836	3	01357	01349	01341	01333	01325	01317
4	05818	05801	05783	05766	05748	05731	4	01310	01302	01294	01286	01278	01270
5	05714	05696	05679	05662	05645	05627	5	01263	01255	01247	01240	01232	01224
6	05610	05593	05576	05559	05542	05525	6	01217	01209	01202	01194	01187	01179
7	05508	05491	05474	05457	05440	05423	7	01172	01164	01157	01150	01142	01135
8	05406	05389	05373	05356	05340	05323	8	01128	01120	01113	01106	01099	01091
9	05306	05290	05273	05257	05240	05224	9	01084	01077	01070	01063	01056	01049
10	0.05207	0519	05174	0515	05142	05125	10	0.01042	01035	01028	1021	01014	01007
11	05109	05093	05076	05060	05044	0502	11	01000	00993	00987	00980	00973	00966
12	05012	04996	04980	04964	04948	04932	12	00960	00953	00946	00940	00933	00926
13	04916	04 00	04884	04868	04852	04837	13	00920	00913	00907	00900	00894	00887
14	04821	04805	04789	04774	04758	0474	14	00881	00874	00868	00862	00855	00849
15	04727	04711	04696	0468	04665	04649	15	00843	00836	0 830	00824	00818	00811
16	04634	04619	04603	04588	04573	0455	16	00805	00799	00793	00787	00781	00775
17	04542	04527	04512	04496	04481	04466	17	00769	00763	00757	00751	00745	00739
18	04451	04436	04421	04406	04391	04376	18	00733	00728	00722	00716	00710	00704
19	04361	04346	04332	04317	04302	04287	19	00699	00693	00687	00682	00676	00670
20	0.04272	0425	04243	04228	04214	04199	20	0.00665	00659	00654	00648	00643	00637
21	04185	04170	04155	04141	04127	04112	21	00632	00626	00621	00616	00610	00605
22	04098	04083	04069	04055	04040	04026	22	00600	00594	00589	00584	00579	00574
23	04012	03998	03983	03969	03955	03941	23	00568	00563	00558	00553	00548	00543
24	03927	03913	03899	03885	03871	03857	24	00538	00533	00528	00523	00518	00513
25	03843	03829	03815	03802	03788	03774	25	00508	00504	00499	00494	00489	00484
26	03760	03746	03733	03719	03706	03692	26	00480	00475	00470	00466	00461	00456
27	03678	03665	03651	03638	03624	03611	27	00452	00447	00443	00438	00434	00429
28	03597	03584	03571	03557	03544	03531	28	00425	00420	00416	00412	00407	00403
29	03517	03504	03491	03478	03465	03452	29	00399	00394	00390	00386	00382	00377
30	0.03438	03425	03412	03399	03386	03373	30	0.00373	00369	00365	00361	00357	00353
31	03360	03348	03335	03322	03309	03296	31	00349	00345	00341	00337	00333	00329
32	03283	03271	03258	03245	03233	03220	32	00325	00321	00317	00313	00310	00306
33	03207	03195	03182	03170	03157	03145	33	00302	00298	0295	00291	00287	00284
34	03132	03120	03107	03095	03083	03070	34	00280	00276	00273	00269	00266	00262
35	03058	03046	03034	03021	03009	02997	35	00259	00255	00252	00249	00245	00242
36	02985	02973	02961	02949	02937	02925	36	00239	00235	00232	00229	00225	00222
37	02913	02901	02889	02877	02865	02853	37	00219	00216	00213	.0210	00207	00203
38	02841	02829	02818	02806	02794	02 83	38	00200	00197	00194	00191	00188	00185
39	02771	02759	02748	02736	02724	02713	39	00183	00180	00177	00174	00171	00168
40	0.02701	02690	02678	02667	02656	02644	40	0.00166	00163	00160	00157	00155	00152
41	02633	02622	02610	02599	02588	02577	41	00149	00147	00144	00142	00139	00137
42	02565	02554	02543	02532	02521	02510	42	00134	00132	00129	00127	00124	00122
43	02499	02488	02477	02466	02455	02444	43	00120	00117	00115	00113	00110	00108
44	02433	02422	02411	02400	02390	02379	44	00106	00104	00102	00099	00097	00095
45	02368	02357	02347	02336	02326	02315	45	00093	00091	00089	00087	00085	00083
46	02304	02294	02283	02273	02262	02252	46	00081	00079	00077	00075	00074	00072
47	02241	02231	02221	02210	02200	02190	47	00070	00068	00066	00065	00063	00061
48	02179	02169	02159	02149	02139	02128	48	00060	00058	00056	00055	00053	00052
49	02118	02108	02098	02088	02078	02068	49	00050	00049	00047	00046	00044	00043
50	0.02058	02048	02038	02028	02018	02009	50	0.00041	00040	00039	00037	00036	00035
51	01999	01989	01979	01969	01960	01950	51	00033	00032	00031	00030	00029	00028
52	01940	01331	01921	01912	01902	01892	52	00026	00025	00024	00023	00022	00021
53	01883	01873	01864	01854	01845	01836	53	00020	00019	00018	00017	00017	00016
54	01826	01817	01808	01798	01789	01780	54	00015	00014	00013	00013	00012	00011
55	01771	01761	01752	01743	01734	01725	55	00010	00010	00009	00008	00008	00007
56	01716	01707	01698	01689	01680	01671	56	00010	00006	00006	00005	00005	00004
57	01662	01653	01644	01635	01626	01618	57	00004	00003	00003	00003	00002	00002
58	01609	01600	01591	01583	01574	01565	58	00002	00001	00001	00001	00001	00001
59	01557	01548	01540	01531	01523	01514	59	00000	00000	00000	00000	00000	00000

TABLE XXIII. For finding the Latitude by two Altitudes of the Sun.

Middle Time.													
0 Hours.								1 Hour.					
M	0″	10″	20″	30″	40″	50″	M	0″	10″	20″	30″	40″	50″
0	2.00000	16270	46373	63982	76476	86167	0	4.71403	71521	71638	71755	71872	71988
1	2.94085	00779	06578	11694	16269	20408	1	72104	72220	72335	72450	72565	72670
2	3.24187	27663	30882	33878	36681	39313	2	72793	72907	73020	73133	73246	73358
3	41796	44144	46371	48490	50510	52440	3	73470	73582	73694	73805	73916	74027
4	54289	56061	57764	59403	60982	62506	4	74137	74247	74357	74466	74575	74684
5	63978	65402	66781	68117	69413	70672	5	74792	74900	75008	75116	75223	75330
6	71895	73085	74242	75370	76469	77542	6	75437	75544	75650	75756	75862	75967
7	78588	76909	80607	81583	82537	83471	7	76072	76177	76281	76385	76489	76593
8	84385	85280	86157	87017	87860	88686	8	76697	76800	76903	77006	77108	77210
9	89498	90294	91076	91845	92600	93341	9	77312	77413	77514	77615	77716	77817
10	3.94071	94788	95494	9618[illegible]	96872	97545	10	4.77917	78017	78117	78217	78316	78415
11	98207	98860	99503	00136	00761	01376	11	78514	78613	78711	78809	78907	79004
12	4.01983	0258[illegible]	03172	03754	04329	04896	12	79101	79198	79295	79392	79488	79584
13	05456	0600[illegible]	06554	07093	07626	08251	13	79680	79776	79871	79966	80061	80156
14	08671	09184	09691	10193	10688	11178	14	80251	8034[illegible]	80439	80533	80627	80720
15	11663	12142	12616	13085	13549	14007	15	80813	80906	80999	81091	81183	81275
16	14461	14911	15355	15796	16231	16663	16	81367	81459	81550	81641	81732	81823
17	17090	17513	17932	18346	18757	19164	17	81914	82004	82094	82184	82274	82364
18	19567	19967	20363	20755	21143	21528	18	82453	82542	82631	82720	82808	82896
19	21910	22289	22664	23036	23405	23770	19	82984	83072	83160	83247	83334	83421
20	4.24133	24493	24849	25202	25553	25901	20	4.83508	8359[illegible]	83682	83768	83854	83940
21	26246	26588	26928	27265	27599	27931	21	84026	84111	84196	84281	84366	84451
22	28260	28587	28911	29233	23553	29870	22	84536	84620	84704	84788	84872	84956
23	30185	30497	30807	31115	31421	31725	23	85039	85122	85205	85288	85371	85454
24	32026	32320	32623	32919	33212	33503	24	85536	85618	85700	85782	85864	85945
25	33793	34080	34365	34649	34931	35211	25	86026	86107	86188	86269	86350	86430
26	35489	35765	36040	36313	36584	36853	26	86510	86590	86670	86750	86830	86910
27	37121	37387	3765[illegible]	37914	38175	38434	27	86989	87068	87147	87226	87304	87382
28	38692	38949	39204	39457	39709	39960	28	87460	87538	87616	87694	87772	87850
29	40209	40456	40702	40947	41190	41432	29	87927	88004	88081	88158	88235	88311
30	4.41673	41912	42150	42386	42622	42856	30	4.88387	88463	88539	88615	88691	88767
31	43088	43320	43550	43779	44007	44233	31	88842	88917	88992	89067	89142	89217
32	44459	44683	44906	45127	45348	45568	32	89291	89365	89439	89513	89587	89661
33	45786	4600[illegible]	46219	46434	46648	46861	33	89735	89808	89881	89954	90027	90100
34	47073	47284	47494	47702	47910	48117	34	90173	90246	90318	90390	90462	90534
35	48323	48527	48731	48934	49136	49336	35	90606	90678	90750	90821	90892	90963
36	49536	49735	49933	50130	50326	50522	36	91034	91105	91176	91247	91317	91387
37	50716	50910	51102	51294	51485	51675	37	91457	91527	91597	91667	91737	91807
38	51864	52052	52240	52426	52612	52797	38	91876	91945	92014	92083	92152	92221
39	52981	53165	53347	53529	53710	53891	39	92290	92358	92426	92494	92562	92630
40	4.54070	54249	54427	54604	54780	54956	40	4.92698	92766	92834	92901	92968	93035
41	55131	55306	55479	55652	55824	55996	41	93102	93169	93236	93303	93369	93435
42	56166	56336	56506	56674	56842	57010	42	93501	93567	93633	93699	93765	93831
43	57177	57343	57508	57673	57837	58000	43	93897	93962	94027	94092	94157	94222
44	58163	58325	58487	58648	58808	58968	44	94287	94352	94417	94481	94545	94609
45	59127	59285	59443	59600	59751	59913	45	94673	94737	94801	94865	94929	94993
46	60069	60224	60378	60532	60685	60838	46	95056	95119	95182	95245	95308	95371
47	60990	61141	61292	61443	61593	61742	47	95434	95497	95559	95621	95683	95745
48	61891	62039	62187	62334	62481	62627	48	95807	95869	95931	95993	96055	96117
49	62773	62918	63063	63207	63351	63494	49	96178	96239	96300	96361	96422	96483
50	4.63637	63779	63921	64062	64203	64343	50	4.96544	96605	96665	96725	96785	96845
51	64483	64622	64761	64899	6503[illegible]	65175	51	96906	96966	97026	97086	97145	97204
52	65312	65448	65584	65720	65855	65990	52	97264	97323	97383	97442	97501	97560
53	66125	66259	66392	66525	66658	66790	53	97618	97677	97736	97794	97853	97911
54	66922	67053	67184	67314	67444	67574	54	97969	98027	98085	98143	98201	98259
55	67703	67832	67961	68089	68217	68344	55	98316	98374	98431	98489	98546	98603
56	68471	68597	68723	6884[illegible]	68974	69099	56	98660	98717	98774	98831	98887	98944
57	69224	69348	69472	69595	69718	69841	57	99000	99057	99113	99169	99225	99281
58	69963	70085	70207	70328	70449	70569	58	99337	99393	99448	99504	99559	99615
59	70689	70809	70928	71047	71166	71285	59	99670	99725	99780	99835	99890	99945

Middle Time.

2 Hours.							3 Hours.					
0″	10″	20″	30″	40″	50″	M	0″	10″	20″	30″	40″	50″
5.00000	00055	00109	00164	00218	00272	0	5.15052	15083	15115	15146	15177	15209
00327	00381	00435	00489	00543	00596	1	15240	15271	15303	15334	15365	15396
00650	00704	00757	00810	00864	00917	2	15427	15458	15489	15520	15551	15582
00970	01023	01076	01129	01182	01234	3	15613	15643	15674	15705	15735	15766
01287	01339	01392	01444	01496	01549	4	15796	15827	15857	15888	15918	15948
01601	01653	01705	01757	01808	01860	5	15979	16009	16039	16069	16099	16129
01912	01963	02014	02066	02117	02168	6	16159	16189	16219	16249	16279	16309
02219	02270	02321	02372	02423	02473	7	16338	16368	16398	16427	16457	16486
02524	02574	02625	02675	02725	02776	8	16516	16545	16575	16604	16633	16662
02826	02876	02926	02976	03026	03075	9	16692	16721	16750	16779	16808	16837
5.03125	03174	03224	03275	03322	03372	10	5.16866	16895	16924	16953	16982	17010
03421	03470	03519	03568	03617	03665	11	17039	17068	17096	17125	17153	17182
03714	03763	03811	03859	03908	03956	12	17210	17239	17267	17296	17324	17352
04004	04052	04100	04148	04196	04244	13	17380	17408	17437	17465	17493	17521
04292	04340	04387	04435	04482	04530	14	17549	17577	17604	17632	17660	17688
04577	04624	04671	04718	04765	04812	15	17716	17743	17771	17798	17826	17854
04859	04906	04953	04999	05046	05092	16	17881	17908	17936	17963	17990	18018
05139	05185	05231	05278	05324	05370	17	18045	18072	18099	18126	18154	18181
05416	05462	05508	05553	05599	05645	18	18205	18235	18261	18228	18315	18342
05690	05736	05781	05827	05872	05917	19	18369	18395	18422	18449	18475	18502
5.05962	06007	06052	06097	06142	06187	20	5.18525	18555	18581	18608	18634	18660
06232	06276	06321	06365	06410	06454	21	18687	18713	18739	18765	18791	18818
06498	06543	06587	06631	06675	07619	22	18844	18870	18896	18922	18948	18973
06763	06807	06851	06894	06938	06981	23	18999	19025	19051	19076	19102	19128
07025	07068	07112	07155	07198	07241	24	19153	19179	19204	19230	19255	19281
07284	07328	07371	07413	07456	07499	25	19306	19331	19357	19382	19407	19432
07542	07584	07627	07670	07712	07754	26	19457	19483	19508	19533	19558	19583
07797	07839	07881	07923	07965	08007	27	19608	19632	19657	19682	19707	19732
08049	08091	08133	08175	08216	08258	28	19756	19781	19806	19831	19855	19879
08300	08341	08383	08424	08465	08507	29	19904	19928	19952	19977	20001	20025
5.08548	08589	08630	08671	08712	08753	30	5.20050	20074	20098	20122	20146	20170
08794	08834	08875	08916	08956	08997	31	20194	20218	20242	20266	20290	20314
09037	09078	09118	09158	09198	09239	32	20338	20362	20385	20409	20433	20456
09279	09319	09359	09399	09438	09478	33	20480	20504	20527	20551	20574	20597
09518	09558	09597	09637	09676	09716	34	20621	20644	20668	20691	20714	20737
09755	19794	09834	09873	09912	09951	35	20760	20784	20807	20830	20853	20876
09990	10029	10068	10107	10146	10184	36	20899	20922	20945	20967	20990	21013
10223	10262	10300	10339	10377	10416	37	21036	21059	21081	21104	21127	21149
10454	10492	10531	10569	10607	10645	38	21172	21194	21217	21239	21261	21284
10683	10721	10759	10797	10834	10872	39	21306	21329	21351	21372	21395	21417
5.10910	10947	10985	11022	11060	11097	40	5.21439	21462	21484	21506	21528	21550
11135	11172	11209	11246	11283	11320	41	21572	21593	21615	21637	21659	21681
11357	11394	11431	11468	11505	11542	42	21702	21724	21746	21767	21789	21810
11578	11615	11652	11688	11725	11761	43	21832	21853	21875	21896	21918	21939
11797	11834	11870	11906	11942	11979	44	21960	21982	22003	22024	22045	22067
12014	12050	12086	12122	12158	12194	45	22088	22109	22130	22151	22172	22193
12229	12265	12301	12336	12372	12407	46	22214	22235	22255	22276	22297	22318
12443	12478	12513	12549	12584	12619	47	22338	22359	22380	22400	22421	22442
12654	12689	12724	12759	12794	12829	48	22462	22483	22503	22524	22544	22564
12864	12898	12933	12968	13002	13037	49	22585	22605	22625	22645	22666	22686
5.13071	13106	13140	13175	13209	13243	50	5.22706	22726	22746	22766	22786	22806
13277	13311	13345	13379	13413	13447	51	22826	22846	22866	22886	22906	22925
13481	13515	13549	13583	13616	13650	52	22945	22965	22984	23004	23024	23043
13684	13717	13751	13784	13818	13851	53	23063	23082	23102	23121	23141	23160
13884	13917	13951	13984	14017	14050	54	23180	23199	23218	23238	23257	23276
14083	14116	14149	14182	14215	14247	55	23295	23314	23333	23352	23372	23391
14280	14313	14345	14378	14411	14443	56	23410	23429	23447	23466	23485	23504
14475	14508	14540	14573	14605	14637	57	23523	23542	23560	23579	23598	23616
14669	14701	14733	14765	14797	14829	58	23635	23654	23672	23691	23709	23728
14861	14893	14925	14957	14988	15020	59	23746	23765	23783	23801	23820	23838

TABLE XXIII. For finding the Latitude by two Altitudes of the Sun.

Middle Time.

	4 Hours.							5 Hours.					
M	0″	10″	20″	30″	40″	50″	M	0″	10″	20″	30″	40″	50″
0	5.23856	23874	23892	23911	23929	23947	0	5.28597	28606	28614	28623	28631	28639
1	23965	23983	24001	24019	24037	24055	1	28648	28656	28664	28673	28681	28689
2	24073	24091	24108	24126	24144	24162	2	28697	28705	28713	28722	28730	28738
3	24179	24197	24215	24232	24250	24267	3	28746	28754	28762	28770	28778	28786
4	24285	24302	24320	24337	24355	24372	4	28793	28801	28809	28817	28825	28833
5	24389	24407	24424	24441	24458	24476	5	28840	28848	28856	28863	28871	28879
6	24493	24510	24527	24544	24561	24578	6	28886	28894	28901	28909	28916	28924
7	24595	24612	24629	24646	24663	24680	7	28931	28939	28946	28953	28961	28968
8	24697	24714	24730	24747	24763	24780	8	28975	28983	28990	28997	29004	29012
9	24797	24813	24830	24846	24863	24879	9	29019	29026	29033	29040	29047	29054
10	5.24896	24912	24929	24945	24961	24978	10	5.29061	29068	29075	29082	29089	29096
11	24994	25010	25027	25043	25059	25075	11	29103	29110	29116	29123	29130	29137
12	25091	25107	25123	25139	25155	25171	12	29143	29150	29157	29163	29170	29177
13	25187	25203	25219	25235	25251	25266	13	29183	29190	29196	29203	29209	29216
14	25282	25298	25314	25329	25345	25360	14	29222	29229	29235	29241	29248	29254
15	25376	25392	25407	25423	25438	25454	15	29260	29267	29273	29279	29285	29292
16	25469	25484	25500	25515	25530	25546	16	29298	29304	29310	29316	29322	29328
17	25561	25576	25591	25607	25622	25637	17	29334	29340	29346	29352	29358	29364
18	25652	25667	25682	25697	25712	25727	18	29370	29375	29381	29387	29393	29399
19	25742	25757	25771	25786	25801	25816	19	29404	29410	29416	29421	29427	29433
20	5.25831	25845	25860	25875	25889	25904	20	5.29438	29444	29449	29455	29460	29466
21	25918	25933	25948	25962	25976	25991	21	29471	29477	29482	29487	29493	29498
22	26005	26020	26034	26048	26063	26077	22	29503	29509	29514	29519	29524	29529
23	26091	26105	26120	26134	26148	26162	23	29535	29540	29545	29550	29555	29560
24	26176	26190	26204	26218	26232	26246	24	29565	29570	29575	29580	29585	29590
25	26260	26274	26288	26301	29315	26329	25	29595	29599	29604	29609	29614	29619
26	26343	26357	26370	26384	26397	26411	26	29623	29628	29633	29637	29642	29647
27	26425	26438	26452	26465	26479	26492	27	29651	29656	29660	29665	29669	29674
28	26506	26519	26532	26546	26559	26572	28	29678	29683	29687	29691	29696	29700
29	26586	26599	26612	26625	26638	26651	29	29704	29709	29713	29717	29721	29726
30	5.26665	26678	26691	26704	26717	26730	30	5.29730	29734	29738	29742	29746	29750
31	26743	26755	26768	26781	26794	26807	31	29754	29758	29762	29766	29770	29774
32	26820	26832	26845	26858	26870	26883	32	29778	29782	29786	29790	29793	29797
33	26896	26908	26921	26933	26946	26958	33	29801	29805	29808	29812	29816	29819
34	26971	26983	26996	27008	27020	27033	34	29823	29827	29830	29834	29837	29841
35	27045	27057	27069	27082	27094	27106	35	29844	29848	29851	29854	29858	29861
36	27118	27130	27142	27154	27166	27178	36	29864	29868	29871	29874	29878	29881
37	27190	27202	27214	27226	27238	27250	37	29884	29887	29890	29893	29896	29900
38	27262	27274	27285	27297	27309	27320	38	29903	29906	29909	29912	29915	29918
39	27332	27344	27355	27367	27379	27390	39	29920	29923	29926	29929	29932	29935
40	5.27402	27413	27425	27436	27447	27459	40	5.29937	29940	29943	29946	29948	29951
41	27470	27481	27493	27504	27515	27526	41	29954	29956	29959	29961	29964	29966
42	27538	27549	27560	27571	27582	27593	42	29969	29971	29974	29976	29979	29981
43	27604	27615	27626	27637	27648	27659	43	29983	29986	29988	29990	29993	29995
44	27670	27681	27692	27703	27713	27724	44	29997	29999	30001	30004	30006	30008
45	27735	27746	27756	27767	27777	27788	45	30010	30012	30014	30016	30018	30020
46	27799	27809	27820	27830	27841	27851	46	30022	30024	30026	30028	30029	30031
47	27862	27872	27882	27893	27903	27913	47	30033	30035	30037	30038	30040	30042
48	27924	27934	27944	27954	27964	27975	48	30043	30045	30047	30048	30050	30051
49	27989	27995	28005	28015	28025	28035	49	30053	30054	30056	30057	30059	30060
50	5.28045	28055	28065	28075	28085	28094	50	5.30062	30063	30064	30066	30067	30068
51	28104	28114	28124	28134	28143	28153	51	30070	30071	30072	30073	30074	30075
52	28163	28172	28182	28191	28201	28211	52	30077	30078	30079	30080	30081	30082
53	28220	28230	28239	28249	28258	28267	53	30083	30084	30085	30086	30086	30087
54	28277	28286	28295	28305	28314	28323	54	30088	30089	30090	30090	30091	30092
55	28332	28342	28351	28360	28369	28378	55	30093	30093	30094	30095	30095	30096
56	28387	28396	28405	28414	28423	28432	56	30096	30097	30097	30098	30098	30099
57	28441	28450	28459	28468	28477	28485	57	30099	30100	30100	30100	30101	30101
58	28494	28502	28512	28520	28529	28538	58	30101	30102	30102	30102	30102	30102
59	28546	28555	28563	28572	28580	28589	59	30103	30103	30103	30103	30103	30103

TABLE XXIII. For finding the Latitude by two Altitudes of the Sun.

Log Rising.

	0 Hour.							1 Hour.					
M	0″	10″	20″	30″	40″	50″	M	0″	10″	20	30″	40″	50″
0	8.00000	42230	02436	37654	62642	02024	0	3.53423	53482	53721	53959	54197	54434
1	97860	11250	22848	33079	42230	50509	1	3.54670	54905	55140	55375	55608	55841
2	9.58066	65019	71455	77448	83054	88319	2	56074	56306	56537	56767	56997	57226
3	93284	67980	02435	06673	10714	14575	3	57455	57683	57910	58137	58363	58589
4	0.18271	21817	25224	28502	31660	34708	4	58814	59038	59262	59486	59708	59930
5	37653	40501	43258	45931	48524	51041	5	60152	60373	60593	60813	61032	61251
6	53488	55868	58184	60440	62639	64784	6	61469	61686	61903	62120	62336	62551
7	66877	68920	70917	72869	74778	76646	7	62766	62980	63194	63407	63620	63832
8	78474	80265	82019	83739	75426	87080	8	64043	64254	64465	64675	64885	65094
9	88703	90297	91862	93399	94905	96394	9	65302	65510	65717	65924	66131	66337
10	1.97854	99289	00699	02091	03458	04805	10	3.66542	66747	66952	67156	67359	67562
11	2.06131	07437	08723	09991	11240	12472	11	67765	67967	68163	68369	68570	68770
12	13687	14885	16066	17223	28382	19517	12	68969	69169	69367	69566	69764	69961
13	20638	21744	22836	23915	24980	26033	13	70157	70354	70550	70745	70940	71135
14	27073	28100	29116	30120	31112	32093	14	71329	71523	71716	71909	72101	72293
15	23063	24023	34972	35916	36839	37758	15	72485	72676	72867	73057	73247	73436
16	28667	29567	40457	41338	42211	43075	16	73625	73813	74001	74189	74376	74563
17	43930	44777	45616	46447	47270	48085	17	74750	74936	75121	75307	75491	75676
18	48893	49693	50486	51271	52050	52821	18	75860	76043	76227	76409	76952	76774
19	53586	54344	55096	55841	56580	57312	19	76955	77137	77318	77498	77678	77858
20	2.58039	58759	59473	60182	60885	61582	20	3.78037	78216	78395	78573	78750	78928
21	62274	62960	63641	64316	64987	65652	21	79105	79282	79458	79634	79809	79985
22	66312	66967	67617	68262	68903	69538	22	80159	80334	80508	80682	80855	81028
23	70169	70796	71418	72036	72649	73258	23	81201	81373	81545	81717	81888	82059
24	73863	74464	75060	75652	76241	76825	24	82230	82400	82570	82739	82908	83077
25	77405	77982	78555	79124	79689	80251	25	83246	83414	83582	83749	83917	84083
26	80809	81363	81914	82461	83005	83546	26	84250	84416	84582	84748	84913	85078
27	84083	84617	85148	85675	86199	86720	27	85242	85406	85570	85734	85897	86060
28	87238	87753	88265	88773	89279	89782	28	86223	86385	86547	86709	86870	87031
29	90282	90779	91273	91765	92254	92740	29	87192	87352	87513	87672	87832	87991
30	2.93223	93703	94181	94656	95129	95599	30	3.88150	88309	88467	88625	88783	88940
31	96067	96532	96994	97454	97912	98367	31	89097	79254	89411	89567	89723	89879
32	98820	99270	99718	00164	00608	01049	32	90034	90189	90344	90498	90653	90807
33	3.01488	01925	02360	02792	03223	03653	33	90960	91114	92167	91420	91572	91724
34	04077	04501	04922	05342	05760	06176	34	91876	92028	92179	92331	92482	92632
35	06590	07001	07411	07819	08225	08630	35	92782	92932	93052	93232	93381	93530
36	09032	09432	09830	10227	10622	11015	36	93679	93827	93975	94123	94271	94418
37	11406	11796	12184	12570	12954	13337	37	94566	94712	94859	95005	95151	95297
38	13718	14097	14475	14850	15225	15597	38	95443	95588	95733	95878	96023	96167
39	15969	16338	16706	17072	17437	17800	39	96311	96455	96599	96742	96885	97028
40	3.18162	18522	18881	19238	19594	19948	40	3.97170	97313	97455	97597	97738	97880
41	20301	20653	21093	21351	21698	22044	41	98021	98162	98302	98442	98583	98723
42	22389	22732	23073	23414	23753	24090	42	98862	99002	99141	99280	99419	99557
43	24427	24762	25095	25428	25759	26089	43	99696	99834	99972	00109	00247	00384
44	26418	26745	27072	27396	27720	28842	44	4.00521	00657	00793	00930	01066	01202
45	28363	28683	29002	29320	29637	29952	45	01337	01473	01608	01743	01877	02012
46	30266	30579	30891	31202	31512	31820	46	02146	02280	02414	02547	02681	02814
47	32128	32434	32739	33044	33347	33649	47	02947	03080	03212	03344	03477	03608
48	33950	34250	34549	34847	35144	35439	48	03740	03871	04003	04134	04265	04395
49	35734	36028	36321	36613	36903	37193	49	04526	04656	04786	04916	05045	05175
50	3.37482	37770	38057	38343	38628	38912	50	4.05304	05433	05561	05690	05818	05946
51	39195	39477	39759	40039	40318	40597	51	06074	06202	06330	06457	06584	06711
52	40875	41151	41247	41702	41976	42250	52	06838	06965	07091	07217	07343	07469
53	42523	42794	43064	43334	43603	43871	53	07595	07720	07845	07970	08095	08220
54	44138	44404	44670	44935	45199	45462	54	08344	08468	08592	88716	08840	08964
55	45724	45986	46247	46507	46765	47024	55	09087	09210	09333	09456	09578	09701
56	47282	47539	47795	48050	48305	48558	56	09823	09945	10067	10188	10310	10431
57	48811	49064	49315	49566	49816	50066	57	10552	10673	10794	10915	11035	11155
58	50314	50562	50809	51056	51301	51547	58	11275	11395	11515	11634	11754	11873
59	3.51791	52035	52278	52520	52761	53002	59	4.11992	12111	12229	12348	12466	12584

TABLE XXIII. For finding the Latitude by two Altitudes of the Sun.

Log Rising.

M	2 Hours 0″	10″	20″	30″	40″	50″	M	3 Hours 0″	10″	20″	30″	40″	50″
0	4.12704	12821	12938	13055	13172	13289	0	4.46671	46747	46823	46899	46975	47051
1	13406	13523	13640	13756	13872	13988	1	47127	47203	47278	47354	47430	47505
2	14104	14220	14336	14451	14566	14682	2	47580	47656	47731	47806	47881	47956
3	14797	14911	15026	15140	15255	15369	3	48031	48106	48180	48255	48330	48404
4	15483	15597	15710	15824	15937	16050	4	48479	48553	48627	48701	48776	48850
5	16162	16275	16387	16501	16614	16726	5	48924	48998	49071	49145	49219	49293
6	16838	16950	17062	17173	17285	17396	6	49366	49440	49513	49586	49659	49733
7	17507	17618	17729	17839	17950	18060	7	49806	49879	49952	50025	50098	50170
8	18171	18281	18391	18500	18610	18719	8	50243	50316	50388	50461	50533	50605
9	18828	18938	19047	19156	19265	19373	9	50677	50750	50822	50894	50966	51038
10	4.19482	19590	19698	19806	19914	20021	10	4.51109	51181	51253	51325	51396	51467
11	20129	20236	20344	20451	20558	20665	11	51539	51610	51681	51753	51824	51895
12	20771	20877	20984	21091	21197	21303	12	51966	52037	52107	52178	52249	52319
13	21409	21515	21620	21725	21831	21936	13	52390	52461	52531	52601	52672	52742
14	22041	22146	22250	22355	22459	22564	14	52812	52882	52952	53022	53092	53162
15	22668	22772	22876	22980	23083	23187	15	53231	53301	53371	53440	53510	53579
16	23290	23393	23496	23599	23702	23805	16	53648	53718	53787	53856	53925	53994
17	23907	24010	24112	24214	24316	24418	17	54063	54132	54201	54269	54338	54407
18	24520	24622	24723	24825	24926	25027	18	54475	54544	54612	54680	54749	54817
19	25128	25229	25330	25430	25531	25631	19	54885	54953	55021	55089	55157	55225
20	4.25731	25831	25931	26031	26131	26231	20	4.55293	55360	55428	55496	55563	55630
21	26330	26429	26529	26628	26727	26826	21	55698	55765	55832	55900	55967	56034
22	26924	27022	27121	27220	27318	27416	22	56101	56168	56235	56301	56368	56435
23	27514	27612	27710	27807	27905	28002	23	56501	56568	56634	56701	56767	56834
24	28099	28197	28294	28391	28487	28584	24	56900	56966	57032	57098	57164	57230
25	28681	28777	28873	28969	29065	29162	25	57296	57362	57428	57494	57559	57625
26	29257	29353	29449	29544	29639	29735	26	57690	57756	57821	57886	57951	58017
27	29832	29925	30020	30115	30209	30304	27	58082	58147	58212	58277	58342	58407
28	30398	30493	30587	30681	30775	30869	28	58471	58536	58601	58665	58730	58794
29	30963	31056	31150	31243	31337	31430	29	58859	58923	58988	59052	59116	59180
30	4.31523	31616	31709	31801	31894	31986	30	4.59244	59308	59372	59436	59500	59564
31	32079	32171	32264	32356	32448	32540	31	59627	59691	59755	59818	59882	59945
32	32631	32723	32815	32906	32997	33089	32	60009	60072	60135	60198	60261	60324
33	33180	33271	33362	33453	33543	33634	33	60387	60450	60513	60576	60639	60701
34	33724	33815	33905	33995	34085	34175	34	60764	60827	60890	60952	61015	61077
35	34265	34355	34444	34534	34623	34713	35	61139	60202	61264	61326	61388	61450
36	34802	34891	34980	35069	35158	35247	36	61512	61574	61636	61698	61760	61822
37	35335	35424	35512	35601	35689	35777	37	61883	61945	62006	62068	62129	62191
38	35865	35953	36041	36128	36216	36303	38	62252	62313	62375	62436	62497	62558
39	36391	36478	36565	36653	36740	36827	39	62619	62680	62741	62802	62863	62923
40	4.36913	37000	37087	37173	37260	37346	40	4.62984	63045	63105	63166	63226	63287
41	37432	37518	37604	37690	37776	37862	41	63347	63407	63468	63528	63588	63648
42	37947	38033	38119	38204	38289	38374	42	63708	63768	63828	63888	63948	64008
43	38459	38544	38629	38714	38799	38884	43	64068	64127	64187	64246	64306	64365
44	38968	39053	39137	39221	39305	39389	44	64425	64484	64544	64603	64662	64721
45	39473	39557	39641	39725	39808	39892	45	64780	64839	64898	64957	65016	65075
46	39975	40059	40142	40225	40308	40391	46	65134	65193	65251	65310	65369	65427
47	40474	40557	40639	40722	40804	40886	47	65486	65544	65602	65661	65719	65777
48	40969	41051	41133	41215	41297	41379	48	65836	65895	65952	66010	66068	66126
49	41461	41542	41624	41706	41787	41868	49	66184	66241	66299	66357	66415	66472
50	4.41950	42031	42112	42193	42274	42355	50	4.66530	66588	66645	66702	66760	66817
51	42435	42516	42597	42677	42758	42838	51	66874	66932	66989	67046	67103	67160
52	42918	42998	43078	43158	43238	43318	52	67217	67274	67331	67388	67445	67502
53	43398	43477	43557	43636	43716	43795	53	67558	67615	67671	67728	67785	67841
54	43874	43953	44032	44111	44190	44269	54	67897	67954	68010	68066	68123	68179
55	44348	44426	44505	44583	44662	44740	55	68235	68291	68347	68403	68459	68515
56	44818	44896	44974	45052	45130	45208	56	68571	68627	68683	68738	68794	68849
57	45286	45363	45441	45518	45596	45673	57	68905	68960	69016	69071	69127	69182
58	45750	45827	45904	45981	46058	46135	58	69237	69292	69348	69403	69458	69513
59	4.46212	46289	46365	46442	46518	46595	59	4.69568	69623	69678	69733	69787	69842

Log Rising.

	4 Hours.							5 Hours.					
M	0″	10″	20″	30″	40″	50″	M	0″	10″	20″	30″	40″	50″
0	4.69897	69952	70006	70061	70115	70170	0	4.86992	87034	87075	87116	87157	87198
1	70224	70279	70333	70387	70442	70496	1	87239	87280	87321	87362	87402	87443
2	70550	70604	70658	70712	70766	70820	2	87484	87525	87566	87606	87647	87688
3	70874	70928	70982	71036	71089	71143	3	87728	87769	87809	87850	87890	87931
4	71197	71250	71304	71357	71411	71464	4	87971	88012	88052	88093	88133	88173
5	71518	71571	71624	71678	71731	71784	5	88213	88254	88294	88334	88374	88414
6	71837	71890	71943	71996	72049	72102	6	88454	88494	88534	88574	88614	88654
7	72155	72208	72260	72313	72360	72418	7	88694	88734	88774	88814	88853	88893
8	72471	72523	72576	72628	72681	72733	8	88933	88973	89012	89052	89091	89131
9	72785	72838	72890	72942	72994	73046	9	89171	89210	89250	89289	89328	89368
10	4.73098	73150	73202	73254	73306	73358	10	4.89407	89447	89486	89525	89564	89604
11	73410	73462	73514	73565	73617	73668	11	89643	89682	89721	89760	89799	89838
12	73720	73772	73823	73874	73926	73977	12	89877	89916	89955	89994	90033	90072
13	74028	74080	74131	74182	74233	74284	13	90111	90149	90188	90227	90266	90305
14	74335	74386	74437	74488	74539	74590	14	90345	90382	90421	90459	90498	90536
15	74641	74692	74742	74793	74844	74894	15	90575	90613	90652	90690	90728	90767
16	74945	74995	75046	75096	75147	75197	16	90805	90843	90882	90920	90958	90996
17	75247	75298	75348	75398	75448	75498	17	91034	91073	91111	91149	91187	91225
18	75549	75599	75649	75699	75748	75798	18	91263	91301	91339	91377	91415	91452
19	75848	75898	75948	75997	76047	76097	19	91490	91528	91566	91605	91644	91679
20	4.76146	76196	76245	76295	76344	76394	20	4.91716	91754	91792	91830	91867	91904
21	76443	76492	76542	76591	76640	76689	21	91942	91979	92017	92054	92092	92129
22	76738	76787	76836	76885	76934	76983	22	92166	92203	92241	92278	92315	92352
23	77032	77081	77130	77179	77227	77276	23	92390	92427	92464	92501	92538	92575
24	77325	77373	77422	77470	77519	77567	24	92612	92649	92686	92722	92760	92796
25	77616	77664	77713	77761	77809	77857	25	92833	92870	92907	92944	92980	93017
26	77906	77954	78002	78050	78098	78146	26	93054	93090	93127	93164	93200	93237
27	78194	78242	78290	78338	78385	78433	27	93273	93310	93346	93383	93419	93455
28	78481	78528	78576	78624	78671	78719	28	93492	93528	93564	93600	93637	93673
29	78767	78814	78861	78908	78956	79003	29	93709	93745	93781	93817	93854	93890
30	4.79051	79098	79145	79192	79240	79287	30	4.93926	93962	93998	94034	94069	94105
31	79334	79381	79428	79475	79522	79568	31	94141	94177	94213	94249	94284	94320
32	79615	79662	79709	79756	79802	79849	32	94356	94392	94427	94463	94498	94534
33	79896	79942	79989	80035	80082	80128	33	94570	94605	94641	94676	94712	94747
34	80175	80221	80267	80314	80360	80406	34	94782	94818	94853	94888	94624	94959
35	80452	80498	80544	80591	80637	80683	35	94994	95029	95065	95100	95135	95170
36	80729	80775	80820	80866	80912	80958	36	95205	95240	95275	95310	95345	95380
37	81004	81049	81095	81141	81186	81232	37	95415	95450	95485	95520	95555	95589
38	81277	81323	81368	81414	81459	81505	38	95624	95659	95694	95728	95763	95798
39	81505	81595	81641	81686	81731	81776	39	95832	95867	95902	95936	95971	96005
40	4.81821	81866	81911	81956	82001	82046	40	4.96040	96074	96109	96143	96177	96212
41	82091	82136	82181	82226	82271	82315	41	96246	96280	96315	96349	96383	96417
42	82360	82405	82449	82494	82538	82583	42	96451	96486	96520	96554	96588	96622
43	82628	82672	82716	82761	82805	82850	43	96656	96690	96724	96758	96792	96826
44	82894	82938	82982	83026	83071	83115	44	96860	96894	96927	96961	96995	97029
45	83159	83203	83247	83291	83335	83379	45	97062	97096	97130	97163	97197	97231
46	83423	83467	83510	83554	83598	83642	46	97264	97293	97331	97365	97398	97432
47	83685	83729	83773	83816	83860	83903	47	97465	97499	97532	97566	97599	97632
48	83947	83990	84034	84077	84120	84164	48	97665	97699	97732	97765	97798	97832
49	84207	84250	84293	84337	84380	84423	49	97865	97898	97931	97964	97997	98030
50	4.84466	84509	84552	84595	84638	84681	50	4.98063	98096	98129	98162	98195	98228
51	84724	84767	84810	84852	84895	84938	51	98261	98293	98326	98358	98392	98425
52	84981	85023	85066	85108	85151	85194	52	98457	98490	98523	98555	98588	98620
53	85236	85278	85321	85363	85406	85448	53	98653	98686	98718	98751	98783	98816
54	85490	85533	85575	85617	85659	85701	54	98848	98880	98913	98945	98978	99010
55	85744	85786	85828	85870	85912	85954	55	99042	99074	99107	99139	99171	99203
56	85996	86037	86079	86121	86163	86205	56	99235	99267	99300	99332	99364	99396
57	86246	86288	86330	86372	86413	86455	57	99428	99460	99492	99524	99556	99587
58	86496	86538	86579	86621	86662	86704	58	99619	99651	99683	99715	99747	99778
59	86745	86786	86828	86869	86910	86957	59	99810	99842	99873	99905	99937	99968

TABLE XXIII. For finding the Latitude by two Altitudes of the Sun.

Log Rising.													
	6 Hours.							7 Hours.					
M	0"	10"	20"	30"	40"	50"	M	0"	10"	20"	30"	40"	50"
0	5.00000	00031	00063	00094	00125	00156	0	5.09996	10020	10044	10068	10092	10116
1	00188	00219	00250	00282	00313	00345	1	10140	10164	10188	10212	10236	10260
2	00376	00407	00438	00469	00501	00532	2	10284	10308	10332	10356	10380	10404
3	00563	00595	00626	00657	00689	00720	3	10429	10453	10477	10501	10525	10549
4	00751	00782	00813	00844	00875	00905	4	10573	10596	10620	10643	10667	10691
5	00936	00967	00998	01028	01059	01090	5	10714	10738	10761	10785	10809	10832
6	01121	01151	01182	01213	01244	01275	6	10856	10879	10903	10926	10950	10974
7	01305	01336	01367	01398	01428	01459	7	10997	11021	11044	11068	11092	11115
8	01490	01520	01550	01580	01611	01641	8	11139	11162	11183	11208	11231	11255
9	01671	01701	01732	01762	01792	01822	9	11278	11301	11324	11347	11370	11393
10	5.01853	01883	01913	01943	01973	02004	10	5.11417	11440	11463	11486	11509	11532
11	02034	02064	02094	02125	02155	02185	11	11556	11579	11602	11625	11648	11671
12	02215	02245	02275	02304	02334	02364	12	11694	11717	11740	11763	11785	11808
13	02394	02423	02453	02483	02512	02542	13	11831	11854	11876	11899	11922	11945
14	02572	02602	02631	02661	02691	02720	14	11967	11990	12013	12036	12058	12080
15	02750	02780	02810	02839	02869	02899	15	12104	12126	12149	12172	12195	12217
16	02928	02958	02987	03016	03045	03074	16	12240	12263	12285	12307	12329	12352
17	03104	03133	03162	03191	03220	03250	17	12374	12396	12419	12441	12463	12486
18	03279	03308	03337	03366	03396	03425	18	12508	12530	12553	12575	12597	12619
19	03454	93483	03512	03542	03571	03600	19	12642	12664	12686	12709	12731	12753
20	5.0362[illegible]	03658	03687	03715	03744	03773	20	5.12776	12798	12820	12841	12863	12885
21	03801	03830	03859	03887	03916	03945	21	12907	12929	12951	12973	13995	13017
22	03974	04002	04031	04060	04088	04117	22	13039	13061	13083	13104	13126	13148
23	04146	04174	04203	04232	04261	04289	23	13170	13192	13214	13236	13258	13280
24	04318	04346	04374	04402	04430	04459	24	13302	13323	13345	13366	13388	13409
25	04487	04515	04543	04571	04600	04628	25	13431	13452	13474	13495	13517	13538
26	04656	04684	04712	04740	04769	04797	26	13560	13581	13603	13624	13646	13667
27	04825	04853	04881	04910	04938	04966	27	13689	13711	13732	13753	13775	13796
28	04994	05022	05050	05077	05105	05133	28	13818	13839	13860	13881	13902	13923
29	05160	05188	05216	05243	05271	05299	29	13944	13966	13987	14008	14029	14050
30	5.05327	05354	05382	05410	05437	05465	30	5.14071	14092	14113	14134	14155	14176
31	05493	05520	05548	05576	05604	05631	31	14198	14219	14240	14261	14282	14303
32	05659	05686	05713	05740	05768	05795	32	14324	14345	14366	14386	14407	14428
33	05822	05849	05876	05904	05931	05958	33	14449	14469	14490	14511	14531	14552
34	05985	06013	06040	06067	06094	06122	34	14573	14593	14614	14635	14656	14676
35	06149	06176	06203	06230	06258	06285	35	14697	14718	14738	14759	14780	14800
36	06312	06339	06365	06392	06419	06445	36	14821	14842	14862	14882	14902	14923
37	06472	06499	06526	06553	06579	06606	37	14943	14963	14984	15004	15024	15045
38	06633	06660	06686	06713	06740	06766	38	15065	15085	15106	15126	15146	15166
39	06793	06820	06847	06873	06900	06927	39	15187	15207	15227	15248	15268	15288
40	5.06954	06980	07[illegible]66	07033	07059	07085	40	5.15309	15329	15349	15369	15388	15408
41	07111	07138	07164	07190	07217	07243	41	15428	15448	15468	15488	15508	15528
42	07269	07295	07322	07348	07374	07400	42	15548	15568	15588	15608	15628	15648
43	07427	07453	07479	07505	07532	07558	43	15667	15687	15707	15727	15747	15767
44	07584	07610	07636	07662	07687	07713	44	15787	15807	15826	15846	15865	15885
45	07739	07765	07791	07816	07842	07868	45	15904	15924	15943	15963	16983	16002
46	07894	07920	07945	07971	07997	08022	46	16022	16041	16061	16080	16100	16119
47	08049	08074	08100	08126	08152	08178	47	16139	16158	16178	16197	16217	16237
48	08203	08229	08254	08280	08305	08330	48	16256	16275	16295	16314	16333	16352
49	08356	08381	08406	08432	08457	08482	49	16371	16390	16410	16429	16448	19467
50	5.08508	08533	08558	08584	08609	08634	50	5.16486	16505	16525	16544	16563	16582
51	08660	08685	08710	08736	08761	08787	51	16601	16620	16640	16659	16678	16697
52	08812	08837	08862	08887	08911	08936	52	16716	16735	16754	16773	16791	16810
53	08961	08986	09011	09036	09061	09086	53	16829	16848	16866	16885	16904	16923
54	09111	09136	09160	09185	09210	09235	54	16942	16960	16979	16998	17017	17036
55	09260	09285	09310	09335	09360	09385	55	17054	17073	17092	17111	17129	17148
56	09409	09434	09458	09483	09507	09532	56	17167	17185	17204	17222	17241	17259
57	09556	09581	09605	09629	09654	09678	57	17277	17296	17314	17333	17351	17369
58	09703	09727	09752	09776	09801	09825	58	17388	17406	17425	17443	17462	17480
59	5.09850	09874	09899	09923	09947	09972	59	17498	17517	17535	17554	17572	17590

TABLE XXIII. For finding the Latitude by two Altitudes of the Sun.

Log Rising.

8 Hours.

M.	0″	10″	20″	30″	40″	50″
0	5.17609	5.17627	5.17645	5.17663	5.17681	5.17699
1	5.17717	5.17735	5.17753	5.17772	5.17790	5.17808
2	5.17826	5.17844	5.17862	5.17880	5.17898	5.17916
3	5.17934	5.17952	5.17970	5.17988	5.18006	5.18024
4	5.18042	5.18060	5.18078	5.18095	5.18113	5.18131
5	5.18148	5.18166	5.18184	5.18202	5.18219	5.18237
6	5.18255	5.18272	5.18290	5.18308	5.18325	5.18343
7	5.18361	5.18378	5.18396	5.18414	5.18431	5.18449
8	5.18467	5.18484	5.18501	5.18519	5.18536	5.18553
9	5.18571	5.18588	5.18605	5.18623	5.18640	5.18657
10	5.18675	5.18692	5.18709	5.18727	5.18744	5.18761
11	5.18779	5.18796	5.18813	5.18831	5.18848	5.18865
12	5.18883	5.18900	5.18917	5.18934	5.18951	5.18968
13	5.18985	5.19002	5.19019	5.19035	5.19052	5.19069
14	5.19086	5.19103	5.19120	5.19137	5.19154	5.19171
15	5.19188	5.19205	5.19222	5.19239	5.19256	5.19273
16	5.19290	5.19307	5.19323	5.19340	5.19356	5.19373
17	5.19390	5.19406	5.19423	5.19440	5.19456	5.19473
18	5.19489	5.19506	5.19523	5.19539	5.19556	5.19572
19	5.19589	5.19606	5.19622	5.19639	5.19656	5.19672
20	5.19689	5.19705	5.19721	5.19738	5.19754	5.19770
21	5.19786	5.19803	5.19819	5.19835	5.19851	5.19868
22	5.19884	5.19900	5.19917	5.19933	5.19949	5.19965
23	5.19982	5.19998	5.20014	5.20030	5.20047	5.20063
24	5.20079	5.20095	5.20111	5.20127	5.20143	5.20159
25	5.20175	5.20191	5.20206	5.20222	5.20238	5.20254
26	5.20270	5.20286	5.20302	5.20318	5.20334	5.20350
27	5.20366	5.20382	5.20398	5.20413	5.20429	5.20445
28	5.20461	5.20477	5.20492	5.20508	5.20523	5.20539
29	5.20555	5.20570	5.20586	5.20601	5.20617	5.20633
30	5.20648	5.20664	5.20679	5.20695	5.20710	5.20726
31	5.20742	5.20757	5.20773	5.20788	5.20804	5.20819
32	5.20835	5.20850	5.20865	5.20881	5.20896	5.20911
33	5.20926	5.20943	5.20957	5.20972	5.20987	5.21002
34	5.21018	5.21033	5.21048	5.21063	5.21079	5.21094
35	1.21109	5.21124	5.21140	5.21155	5.21170	5.21185
36	5.21201	5.21215	5.21230	5.21245	5.21260	5.21275
37	5.21290	5.21305	5.21320	5.21335	5.21350	5.21364
38	5.21379	5.21394	5.21409	5.21424	5.21439	5.21454
39	5.21469	5.21484	5.21499	5.21513	5.21528	5.21543
40	5.21558	5.21573	5.21587	5.21602	5.21616	5.21631
41	5.21645	5.21660	5.21675	5.21689	5.21704	5.21718
42	5.21733	5.21747	5.21762	5.21777	5.21791	5.21806
43	5.21820	5.21835	5.21849	5.21864	5.21878	5.21893
44	5.21908	5.21922	5.21936	5.21950	5.21964	5.21979
45	5.21993	5.22007	5.22021	5.22036	5.22050	5.22064
46	5.22078	5.22092	5.22107	5.22121	5.22135	5.22149
47	5.22164	5.22178	5.22192	5.22206	5.22221	5.22235
48	5.22249	5.22263	5.22277	5.22291	5.22305	5.22318
49	5.22332	5.22346	5.22360	5.22374	5.22388	5.22402
50	5.22416	5.22430	5.22444	5.22457	5.22471	5.22485
51	5.22499	5.22513	5.22527	5.22541	5.22555	5.22569
52	5.22583	5.22596	5.22610	5.22623	5.22637	5.22650
53	5.22664	5.22678	5.22691	5.22705	5.22718	5.22732
54	5.22745	5.22759	5.22773	5.22786	5.22800	5.22813
55	5.22827	5.22840	5.22854	5.22868	5.22881	5.22895
56	5.22908	5.22921	5.22935	5.22948	5.22961	5.22974
57	5.22988	5.23001	5.23014	5.23027	5.23040	5.23054
58	5.23067	5.23080	5.23093	5.23107	5.23120	5.23133
59	5.23146	5.23160	5.23173	5.23186	5.23199	5.232[illegible]3

	0°		1°		2°		3°		4°		
M.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	M.
0	00	100000	1745	99985	3490	99939	5234	99863	6976	99756	60
1	29	0000	1774	984	3519	938	5263	861	7005	754	59
2	58	0000	1803	984	3548	937	5292	860	7034	752	58
3	87	0000	1832	983	3577	936	5321	858	7063	750	57
4	116	0000	1862	983	3606	935	5350	857	7092	748	56
5	145	0000	1891	982	3635	934	5379	855	7121	746	55
6	175	0000	1920	982	3664	933	5408	854	7150	744	54
7	204	100000	1949	99981	3693	99932	5437	99852	7179	99742	53
8	233	0000	1978	980	3723	931	5466	851	7208	740	52
9	262	0000	2007	980	3752	930	5495	849	7237	738	51
10	291	0000	2036	979	3781	929	5524	847	7266	736	50
11	320	99999	2065	979	3810	927	5553	846	7295	734	49
12	349	9999	2094	978	3839	926	5582	844	7324	731	48
13	378	99999	2123	99977	3868	99925	5611	99842	7353	99729	47
14	407	999	2152	977	3897	924	5640	841	7382	727	46
15	436	999	2181	976	3926	923	5669	839	7411	725	45
16	465	999	2211	976	3955	922	5698	838	7440	723	44
17	495	999	2240	975	3984	921	5727	836	7469	721	43
18	524	999	2269	974	4013	919	5756	834	7498	719	42
19	553	99998	2298	99974	4042	99918	5785	99833	7527	99716	41
20	582	9998	2327	973	4071	917	5814	831	7556	714	40
21	611	9998	2356	972	4100	916	5844	829	7585	712	39
22	640	9998	2385	972	4129	915	5873	827	7614	710	38
23	669	9998	2414	971	4159	913	5902	826	7643	708	37
24	698	9998	2443	970	4188	912	5931	824	7672	705	36
25	727	99997	2472	99969	4217	99911	5960	99822	7701	99703	35
26	756	997	2501	969	4246	910	5989	821	7730	701	34
27	785	997	2530	968	4275	909	6018	819	7759	699	33
28	814	997	2560	967	4304	907	6047	817	7788	696	32
29	844	996	2589	966	4333	906	6076	815	7817	694	31
30	873	996	2618	966	4362	905	6105	813	7846	692	30
31	902	99996	2647	99965	4391	99904	6134	99812	7875	99689	29
32	931	996	2676	964	4420	902	6163	810	8904	687	28
33	960	995	2705	963	4449	901	6192	808	7933	685	27
34	989	995	2734	963	4478	900	6221	806	7962	683	26
35	1018	995	2763	962	4507	898	6250	804	7991	680	25
36	1047	995	2792	961	4536	897	6279	803	8020	678	24
37	1076	99994	2821	99960	4565	99896	6308	99801	8049	99676	23
38	1105	994	2850	959	4594	894	6337	799	8078	673	22
39	1134	994	2879	959	4623	893	6366	797	8107	671	21
40	1164	993	2908	958	4653	892	6395	795	8136	668	20
41	1193	993	2938	957	4682	890	6424	793	8165	666	19
42	1222	993	2967	956	4711	889	6453	792	8194	664	18
43	1251	99992	2996	99955	4740	99888	6482	99790	8223	99661	17
44	1280	992	3025	954	4769	886	6511	788	8252	659	16
45	1309	991	3054	953	4798	885	6540	786	8281	657	15
46	1338	991	3083	952	4827	883	6569	784	8310	654	14
47	1367	991	3112	952	4856	882	6598	782	8339	652	13
48	1396	990	3141	951	4885	881	6627	780	8368	649	12
49	1425	99990	3170	99950	4914	99879	6656	99778	8397	99647	11
50	1454	989	3199	949	4943	878	6685	776	8426	644	10
51	1483	989	3228	948	4972	876	6714	774	8455	642	9
52	1513	989	3257	947	5001	875	6743	772	8484	639	8
53	1542	988	3286	946	5030	873	6773	770	8513	637	7
54	1571	988	3316	945	5059	872	6802	768	8542	635	6
55	1600	99987	3345	99944	5088	870	6831	99766	8571	99632	5
56	1629	987	3374	943	5117	869	6860	764	8600	630	4
57	1658	986	3403	942	5146	867	6889	762	8629	627	3
58	1687	986	3432	941	5175	866	6918	760	8658	625	2
59	1716	985	3461	940	5205	864	5947	758	8687	622	1
60	1745	985	3490	939	5234	863	6976	756	8716	619	0
M.	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	M.
	89°		88°		87°		86°		85°		

	5°		6°		7°		8°		9°		
M.	N fine	N cof.	N fine	N cof.	N fine	N cof.	N fine	N cof.	N fine	N cof.	M.
0	8716	99619	10453	99452	12187	99255	13917	99027	15643	98769	60
1	8745	617	482	449	216	251	646	023	672	764	59
2	8774	614	511	446	245	248	975	019	701	760	58
3	8803	612	540	443	274	244	14004	015	730	755	57
4	8831	609	569	440	302	240	033	011	758	751	56
5	8860	607	597	437	331	237	061	006	787	746	55
6	8889	604	626	434	360	233	090	002	816	741	54
7	8918	99602	10655	99431	12389	99230	14119	98998	15845	98737	53
8	8947	599	684	428	418	226	148	994	873	732	52
9	8976	596	713	424	447	222	177	990	902	728	51
10	9005	594	742	421	476	219	205	986	931	723	50
11	9034	591	771	418	504	215	234	982	959	718	49
12	9063	588	800	415	533	211	263	978	988	714	48
13	9092	99586	10829	99412	12562	99208	14292	98973	16017	98709	47
14	9121	583	858	409	591	204	320	969	046	704	46
15	9150	580	887	406	620	200	349	965	074	700	45
16	9179	578	916	402	649	197	378	961	103	695	44
17	9208	575	945	399	678	193	407	957	132	690	43
18	9237	572	973	396	706	189	436	953	160	686	42
19	9266	99570	11002	99393	12735	99186	14464	98948	16189	98681	41
20	9295	567	031	390	764	182	493	944	218	676	40
21	9324	564	060	386	793	178	522	940	246	671	39
22	9353	562	089	383	822	175	551	936	275	667	38
23	9382	559	118	380	851	171	580	931	304	662	37
24	9411	556	147	377	880	167	608	927	333	657	36
25	9440	99553	11176	99374	12908	99163	14637	98923	16361	98652	35
26	9469	551	205	370	937	160	666	919	390	648	34
27	9498	548	234	367	966	156	695	914	419	643	33
28	9527	545	263	364	995	152	723	910	447	638	32
29	9556	542	291	360	13024	148	752	906	476	633	31
30	9585	540	320	357	053	144	781	902	505	629	30
31	9614	99537	11349	99354	13081	99141	14810	98897	16533	98624	29
32	9642	534	378	351	110	137	838	893	562	619	28
33	9671	531	407	347	139	133	867	889	591	614	27
34	9700	528	436	344	168	129	896	884	620	609	26
35	9729	526	465	341	197	125	925	880	648	604	25
36	9758	523	494	337	226	122	954	876	677	600	24
37	9787	99520	11523	99334	13254	99118	14982	98871	16706	98595	23
38	9816	517	552	331	283	114	15011	867	734	590	22
39	9845	514	580	327	312	110	040	863	763	685	21
40	9874	511	609	324	341	106	069	858	792	580	20
41	9903	508	638	320	370	102	097	854	820	575	19
42	9932	506	667	317	399	098	126	849	849	570	18
43	9961	99503	11696	99314	13427	99094	15155	98845	16878	98565	17
44	9990	500	725	310	456	091	184	841	906	561	16
45	10019	497	754	307	485	087	212	836	935	556	15
46	048	494	783	303	514	083	241	832	964	551	14
47	077	491	812	300	543	079	270	827	992	546	13
48	106	488	840	297	572	075	299	823	17021	541	12
49	10135	99485	11869	99293	13600	99071	15327	98818	17050	98536	11
50	164	482	898	290	629	067	356	814	078	531	10
51	192	479	927	286	658	063	385	809	107	526	9
52	221	476	956	283	687	059	414	805	136	521	8
53	250	473	985	279	716	055	442	800	164	516	7
54	279	470	12014	276	744	051	471	796	193	511	6
55	10308	99467	12043	99272	13773	99047	15500	98791	17222	98506	5
56	337	464	071	269	802	043	529	787	250	502	4
57	366	461	100	265	831	039	557	782	279	496	3
58	395	458	129	262	860	035	586	778	308	491	2
59	424	455	158	258	889	031	615	773	336	486	1
60	453	452	187	255	917	027	643	769	365	481	0
M.	N cof.	N fine	N cof.	N fine	N cof.	N fine	N cof.	N fine	N cof.	N fine	M.
	84°		83°		82°		81°		80°		

TABLE XXIV. OF NATURAL SINES.

	10°		11°		12°		13°		14°		
M	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	M
0	17365	98481	19081	98163	20791	97815	22495	97437	24192	97030	60
1	393	476	109	157	820	809	523	430	220	023	59
2	422	471	138	152	848	803	552	424	249	015	58
3	451	466	167	146	877	797	580	417	277	008	57
4	479	461	195	140	905	791	608	411	305	001	56
5	508	455	224	135	938	784	637	404	333	96994	55
6	537	450	254	129	962	778	665	398	362	987	54
7	17565	98445	19281	98124	20990	97772	22693	97391	24320	96980	53
8	594	440	309	118	21019	766	722	384	418	973	52
9	623	435	338	112	047	760	750	378	446	966	51
10	651	430	366	107	076	754	778	371	474	959	50
11	680	425	395	101	104	748	807	365	503	952	49
12	708	420	423	096	132	742	835	358	531	945	48
13	17737	98414	19452	98090	21161	97735	22863	97351	24559	96937	47
14	766	409	481	084	189	729	892	345	587	930	46
15	794	404	509	079	218	723	920	338	615	923	45
16	823	399	538	073	246	717	948	331	644	916	44
17	852	394	566	067	275	711	977	325	672	909	43
18	880	389	595	061	303	705	23005	318	700	902	42
19	17909	98383	19623	98056	21331	97698	23033	97311	24728	96894	41
20	937	378	652	050	360	692	062	304	756	887	40
21	966	373	680	044	388	686	090	298	784	880	39
22	995	368	709	039	417	680	118	291	813	873	38
23	18023	362	737	033	445	673	146	284	841	866	37
24	052	357	765	027	474	667	174	278	869	858	36
25	18081	98352	19794	98021	21502	97661	23202	97271	24897	96851	35
26	109	347	823	016	530	655	231	264	925	844	34
27	138	341	851	010	559	648	259	257	953	837	33
28	166	336	880	004	587	642	287	251	982	829	32
29	195	331	908	97998	616	636	316	244	25010	822	31
30	224	325	937	992	644	630	344	237	038	815	30
31	18252	98320	19965	97987	21672	97623	23373	97230	25066	96807	29
32	281	315	994	981	701	617	401	223	094	800	28
33	309	310	20022	975	729	611	429	217	122	793	27
34	338	304	051	969	758	604	457	210	151	786	26
35	367	299	079	963	786	598	486	203	179	778	25
36	395	294	108	958	814	592	514	196	207	771	24
37	18424	98288	20136	97952	21843	97585	23542	97189	25235	96764	23
38	452	283	165	946	871	579	571	182	263	756	22
39	481	277	193	940	899	573	599	176	291	749	21
40	509	272	222	934	928	566	627	169	320	742	20
41	538	267	250	928	956	560	656	162	348	734	19
42	567	261	279	922	985	553	684	155	376	727	18
43	18595	98256	20307	97916	22013	97547	23712	97148	25404	96719	17
44	624	250	336	910	041	541	740	141	432	712	16
45	652	245	364	905	070	534	769	134	460	705	15
46	681	240	393	899	098	528	797	127	488	697	14
47	710	234	421	893	126	521	825	120	516	690	13
48	738	229	450	887	155	515	853	113	545	682	12
49	18767	98223	20478	97881	22183	97508	23882	97106	25573	9667	11
50	795	218	507	875	212	502	910	100	601	667	10
51	824	212	535	869	240	496	938	093	629	660	9
52	852	207	563	863	268	489	966	086	657	653	8
53	881	201	592	857	297	483	995	079	685	645	7
54	910	196	620	851	325	476	24023	072	713	638	6
55	18938	98190	20649	97845	22353	97470	24051	97065	25741	96630	5
56	967	185	677	839	382	463	079	058	769	623	4
57	995	179	706	833	410	457	108	051	798	615	3
58	19024	174	734	827	438	450	136	044	826	608	2
59	052	168	763	821	467	444	164	037	854	600	1
60	081	163	791	815	495	437	192	030	882	593	0
M	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	M.
	79°		78°		77°		76°		75°		

TABLE XXIV. OF NATURAL SINES.

	15°		16°		17°		18°		19°		
M	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	M
0	25882	96593	27564	96126	29237	95630	30902	95106	32557	94552	60
1	910	585	592	118	265	622	929	097	584	542	59
2	938	578	620	110	293	613	957	088	612	533	58
3	966	570	648	102	321	605	985	079	639	523	57
4	994	362	676	094	348	596	31012	070	667	514	56
5	26022	555	704	086	376	588	040	061	694	504	55
6	050	547	731	078	404	579	068	052	722	495	54
7	26077	96540	27759	96070	29432	95571	31095	95043	32749	94485	53
8	105	532	787	062	460	562	123	033	777	476	52
9	133	524	815	054	487	554	151	024	804	466	51
10	161	517	843	046	515	545	178	015	832	457	50
11	191	509	871	037	543	536	206	006	859	447	49
12	219	502	899	029	571	528	233	94997	887	438	48
13	26247	96494	27927	96021	29599	95519	31261	94988	32914	94428	47
14	275	486	955	013	626	511	289	979	942	418	46
15	303	479	983	005	654	502	316	970	969	409	45
16	331	471	28011	95997	682	493	344	961	997	399	44
17	359	463	039	989	710	485	372	952	33024	390	43
18	387	456	067	981	737	476	399	943	051	380	42
19	26415	96448	28095	95972	29765	95467	31427	94933	33079	94370	41
20	443	440	123	964	793	459	454	924	106	361	40
21	471	433	150	956	821	450	482	915	134	351	39
22	500	425	178	948	849	441	510	906	161	342	38
23	528	417	206	940	876	433	537	897	188	332	37
24	556	410	234	931	904	424	565	888	215	323	36
25	26584	96402	28262	95923	29932	95415	31593	94878	33244	94313	35
26	612	394	290	915	960	407	620	869	271	303	34
27	640	386	318	907	987	398	648	860	298	293	33
28	668	379	346	898	30015	389	675	851	326	284	32
29	696	371	374	890	043	380	703	842	353	274	31
30	724	363	402	882	071	372	730	832	381	264	30
31	26752	96355	28429	95874	30098	95363	31758	94823	33408	94254	29
32	780	347	457	865	126	354	786	814	436	245	28
33	808	340	485	857	154	345	813	805	463	235	27
34	836	332	513	849	182	337	841	795	490	225	26
35	864	324	541	841	209	328	868	786	518	215	25
36	892	316	569	832	237	319	896	777	545	206	24
37	26920	96308	28597	95824	30265	95310	31923	94768	33573	94196	23
38	948	301	625	816	292	301	951	758	600	186	22
39	976	293	652	807	320	293	979	749	627	176	21
40	27004	285	680	799	348	284	32006	740	655	167	20
41	032	277	708	791	376	275	034	730	682	157	19
42	060	269	736	782	403	266	061	721	710	147	18
43	27088	96261	28764	95774	30431	95257	32089	94712	33737	94137	17
44	116	253	792	766	459	248	116	702	764	127	16
45	144	246	820	757	486	240	144	693	792	118	15
46	172	238	847	749	514	231	171	684	819	108	14
47	200	230	876	740	542	222	199	674	846	098	13
48	228	222	903	732	570	213	227	665	874	088	12
49	27256	96214	28931	95724	30597	95204	32254	94656	33901	94078	11
50	284	206	959	715	625	195	282	646	929	068	10
51	312	198	987	707	653	186	309	637	956	058	9
52	340	190	29015	698	680	177	337	627	983	049	8
53	368	182	042	690	708	168	364	618	34011	039	7
54	396	174	070	681	736	159	391	609	038	029	6
55	27424	96166	29098	95673	30763	95150	32419	94599	34065	94019	5
56	452	158	126	664	791	142	447	590	093	009	4
57	480	150	154	656	819	133	474	580	120	93999	3
58	508	142	182	647	846	124	502	571	147	989	2
59	536	134	209	639	874	115	529	561	175	979	1
60	564	126	237	630	902	106	557	552	202	969	0
M	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	M
	74°		73°		72°		71°		70°		

Table XXIV. Of Natural Sines.

	20°		21°		22°		23°		24°		
M	N fine	N cof.	N fine	N cof.	N fine	N cof.	N fine	N cof	N fine	N cof	M
0	34202	93969	35837	93358	37461	92718	39073	92050	40674	91355	60
1	229	959	864	348	488	707	100	039	700	343	59
2	257	949	891	337	515	697	127	028	727	331	58
3	284	939	918	327	542	686	153	016	753	319	57
4	311	929	645	316	569	675	180	005	780	307	56
5	336	919	973	306	595	664	207	91994	806	295	55
6	366	909	36000	295	622	653	234	982	833	283	54
7	34393	93899	36027	93285	37649	92642	39260	91971	40860	91272	53
8	421	889	054	274	676	631	287	959	886	260	52
9	448	879	081	264	703	620	314	948	913	248	51
10	475	869	108	253	730	609	341	936	939	236	50
11	503	859	135	243	757	598	367	925	966	224	49
12	530	849	162	232	784	587	394	914	992	212	48
13	34557	93839	36190	93222	37811	92576	39421	91902	41019	91200	47
14	584	829	217	211	838	565	448	891	045	188	46
15	612	819	244	201	865	554	474	879	072	176	45
16	639	809	271	190	892	543	501	868	098	164	44
17	666	799	298	180	919	532	528	856	125	152	43
18	694	789	325	169	946	521	555	845	151	140	42
19	34721	93779	36352	93159	37973	92510	39581	91833	41178	91128	41
20	748	769	379	148	999	499	608	822	204	116	40
21	775	759	406	137	38026	488	635	810	231	104	39
22	803	748	434	127	053	477	661	799	257	092	38
23	830	738	461	116	080	466	688	787	284	080	37
24	857	728	488	106	107	455	715	775	310	068	36
25	34884	93718	36515	93095	38134	92444	39741	91764	41337	91056	35
26	912	708	542	084	161	432	768	752	363	044	34
27	939	698	569	074	188	421	795	741	390	032	33
28	966	688	596	063	215	410	822	729	416	020	32
29	993	677	623	052	241	399	848	718	443	008	31
30	35021	667	650	042	268	388	875	706	469	90996	30
31	35048	93657	36677	93031	38295	92377	39902	91694	41496	90984	29
32	075	647	704	020	322	366	928	683	522	972	28
33	102	637	731	010	349	355	955	671	549	960	27
34	130	626	758	92999	376	343	982	660	575	948	26
35	157	616	785	998	403	332	40008	648	602	936	25
36	184	606	812	978	430	321	035	636	628	924	24
37	35211	93596	36839	92967	38456	92310	40062	91625	41655	90911	23
38	239	585	867	959	483	299	088	613	681	899	22
39	266	575	894	945	510	287	115	601	707	887	21
40	293	565	921	935	537	276	141	590	734	875	20
41	320	555	948	924	564	265	168	578	760	863	19
42	347	544	975	913	591	254	195	566	787	851	18
43	35375	93534	37002	92902	38617	92243	40221	91555	41813	90839	17
44	402	524	029	892	644	231	248	543	840	826	16
45	429	514	056	881	671	220	275	531	866	814	15
46	456	503	083	870	698	209	301	519	892	802	14
47	484	493	110	859	725	198	328	508	919	790	13
48	511	483	137	849	752	186	355	496	945	778	12
49	35538	93472	37164	92838	38778	92175	40381	91484	41972	90766	11
50	565	462	191	827	805	164	408	472	998	753	10
51	592	452	218	816	832	152	434	461	42024	741	9
52	619	441	245	805	859	141	461	449	051	729	8
53	647	431	272	794	886	130	488	437	077	717	7
54	674	420	299	784	912	119	514	425	104	704	6
55	35701	93410	37326	92773	38939	92107	40541	91414	42130	90692	5
56	728	400	353	762	966	096	567	402	156	680	4
57	755	389	380	751	993	085	594	390	183	668	3
58	782	379	407	740	39020	073	621	378	209	655	2
59	810	368	434	729	046	062	647	366	235	643	1
60	837	358	461	718	073	050	674	355	262	631	0
M	N cof.	N fine	N cof.	N fine	N cof.	N fine	N cof.	N fine	N cof.	N fine	M
	69°		68°		67°		66°		65°		

Table XXIV. Of Natural Sines.

	25°		26°		27°		28°		29°		
M.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	M.
0	42262	90631	43837	89879	45399	89101	46947	88295	48481	87462	60
1	288	618	863	867	425	087	973	281	506	448	59
2	315	606	889	854	451	074	999	267	532	434	58
3	341	594	916	841	477	061	47024	254	557	420	57
4	367	582	942	828	503	048	050	240	583	406	56
5	394	569	968	816	529	035	076	226	608	391	55
6	420	557	994	803	554	021	101	213	634	377	54
7	42446	90545	44020	89790	45580	89008	47127	88199	48659	87363	53
8	473	532	046	777	606	88995	153	185	684	349	52
9	499	520	072	764	632	981	178	172	710	335	51
10	525	507	098	752	658	968	204	158	735	321	50
11	552	495	124	739	684	955	229	144	761	306	49
12	578	483	151	726	710	942	255	130	786	292	48
13	42604	90470	44177	89713	45736	88928	47281	88117	48811	87278	47
14	631	458	203	700	762	915	306	103	837	264	46
15	657	446	229	687	787	902	332	089	862	250	45
16	683	433	255	674	813	888	358	075	888	235	44
17	709	421	281	662	839	875	383	062	913	221	43
18	736	408	307	649	865	862	409	048	938	207	42
19	42762	90396	44333	89636	45891	88848	47434	88034	48964	87193	41
20	788	383	359	623	917	835	460	020	989	178	40
21	815	371	385	610	942	822	486	006	49014	164	39
22	841	358	411	597	968	808	511	87993	040	150	38
23	897	346	437	584	994	795	537	979	065	136	37
24	894	334	464	571	46020	782	562	965	090	121	36
25	42920	90321	44490	89558	46046	88768	47588	87951	49116	87107	35
26	946	309	516	545	072	755	614	937	141	093	34
27	972	296	542	532	097	741	639	923	166	079	33
28	999	284	568	519	123	728	665	909	192	064	32
29	43025	271	594	506	149	715	690	896	217	050	31
30	051	259	620	493	175	701	716	882	242	036	30
31	43077	90246	44646	89480	46201	88688	47741	87868	49268	87021	29
32	104	233	672	467	226	674	767	854	293	007	28
33	130	221	698	454	252	661	793	840	318	86993	27
34	156	208	724	441	278	647	818	826	344	978	26
35	182	196	750	428	304	634	844	812	369	964	25
36	209	183	776	415	330	620	869	798	394	949	24
37	43235	90171	44802	89402	46355	88607	47895	87784	49419	86935	23
38	261	158	828	389	381	593	920	770	445	921	22
39	287	146	854	376	407	580	946	756	470	906	21
40	313	133	880	363	433	566	971	743	495	892	20
41	340	120	906	350	458	553	997	729	521	878	19
42	366	108	932	337	484	539	48022	715	546	863	18
43	43392	90095	44958	89324	46510	88526	48048	87701	49571	86849	17
44	418	082	984	311	536	512	073	687	596	834	16
45	445	070	45010	298	561	499	099	673	622	820	15
46	471	057	036	285	587	485	124	659	647	805	14
47	497	045	062	272	613	472	150	645	672	791	13
48	523	032	088	259	639	458	175	631	697	777	12
49	43549	90019	45114	89245	46664	88445	48201	87617	49722	86762	11
50	575	007	140	232	690	431	226	603	748	748	10
51	602	89994	166	219	716	417	252	589	773	733	9
52	628	981	192	206	742	404	277	575	798	719	8
53	654	968	218	193	767	390	303	561	824	704	7
54	680	956	243	180	793	377	328	546	849	690	6
55	43706	89943	45269	89167	46819	88363	48354	87532	49874	86675	5
56	733	930	295	153	844	349	379	518	899	661	4
57	759	918	321	140	870	336	405	504	924	646	3
58	785	905	347	127	896	322	430	490	950	632	2
59	811	892	373	114	921	308	456	476	975	617	1
60	837	879	399	101	947	295	481	462	50000	603	0
M.	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	M.
	64°		63°		62°		61°		60°		

	30°		31°		32°		33°		34°		
M.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	M.
0	50000	86603	51504	85717	52992	84805	54464	83867	55919	82904	60
1	025	588	529	702	53017	789	488	851	943	887	59
2	050	573	554	687	041	774	512	835	968	871	58
3	076	559	579	672	066	759	537	819	992	855	57
4	101	544	604	657	091	743	561	804	56016	839	56
5	126	530	628	642	115	728	586	788	040	822	55
6	151	515	653	627	140	712	610	772	064	806	54
7	50176	86501	51670	85612	53164	84697	54635	83756	56088	82790	53
8	201	486	703	597	189	681	659	740	112	773	52
9	227	471	728	582	214	666	683	724	136	757	51
10	252	457	753	567	238	650	708	708	160	741	50
11	277	442	778	551	263	635	732	692	184	724	49
12	302	427	803	536	288	619	756	676	208	708	48
13	50327	86413	51828	85521	53312	84604	54781	83660	56232	82692	47
14	352	398	852	506	337	588	805	645	256	675	46
15	377	384	877	491	361	573	829	629	280	659	45
16	403	369	902	476	386	557	854	613	305	643	44
17	428	354	927	461	411	542	878	597	329	626	43
18	453	340	952	446	435	526	902	581	353	610	42
19	50478	56325	51977	85431	53460	84511	54927	83565	56377	82593	41
20	503	310	52002	416	484	495	951	549	401	577	40
21	528	295	026	401	509	480	975	533	425	561	39
22	553	281	051	385	534	464	999	517	449	544	38
23	578	266	076	370	558	448	55024	501	473	528	37
24	603	251	101	355	583	433	048	485	497	511	36
25	50628	86237	52126	85340	53007	84417	55072	83469	56521	82495	35
26	654	222	151	325	632	402	097	453	545	478	34
27	679	207	175	310	656	386	121	437	569	462	33
28	704	192	200	294	681	370	145	421	593	446	32
29	729	178	225	279	705	355	169	405	617	429	31
30	754	163	250	264	730	339	194	389	641	413	30
31	50779	86148	52275	85249	53754	84324	55218	83373	56665	82396	29
32	804	133	299	234	779	308	242	356	689	380	28
33	829	119	324	218	804	292	266	340	713	363	27
34	854	104	349	203	828	277	291	324	736	347	26
35	879	089	374	188	853	261	315	308	760	330	25
36	904	074	399	173	877	245	339	292	784	314	24
37	50929	86059	52423	85157	53902	84230	55363	83276	56808	82297	23
38	954	045	448	142	926	214	388	260	832	281	22
39	979	030	473	127	951	198	412	244	856	264	21
40	51004	015	498	112	975	182	436	228	880	248	20
41	029	000	522	096	54000	167	460	212	904	231	19
42	054	85985	547	081	024	151	484	195	928	214	18
43	51079	85970	52572	85066	54049	84135	55509	83179	56952	82198	17
44	104	956	597	051	073	120	533	163	976	181	16
45	129	941	621	035	097	104	557	147	57000	165	15
46	154	926	646	020	122	088	581	131	024	148	14
47	179	911	671	005	146	072	605	115	047	132	13
48	204	896	696	84989	171	057	630	098	071	115	12
49	51229	85881	52720	84974	54195	84041	55654	83082	57095	82098	11
50	254	866	745	959	220	025	678	066	119	082	10
51	279	851	770	943	244	009	702	050	143	065	9
52	304	836	794	928	269	83994	726	034	167	048	8
53	329	821	819	913	293	978	750	017	191	032	7
54	354	806	844	897	317	962	775	001	215	015	6
55	51379	85792	52869	84882	54342	[illegible]	[illegible]	[illegible]	57238	81999	5
56	404	777	893	866	366	930	[illegible]	[illegible]	262	982	4
57	429	762	918	851	391	915	[illegible]	952	286	965	3
58	454	747	943	836	415	899	[illegible]	936	310	949	2
59	479	732	[illegible]	[illegible]	440	883	891	920	334	932	1
60	504	717	[illegible]	[illegible]	464	867	[illegible]	904	358	915	0
M.	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	M.
	59°		58°		57°		56°		55°		

Table XXIV. Of Natural Sines.

	35°		36°		37°		38°		39°		
M.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	M.
0	57358	81915	58779	80902	60182	79864	61566	78801	62932	77715	60
1	381	899	802	885	205	846	589	783	955	696	59
2	405	882	826	867	228	829	612	765	977	678	58
3	429	865	849	850	251	811	635	747	63000	660	57
4	453	848	873	833	274	793	658	729	022	641	56
5	477	832	896	816	298	776	681	711	045	623	55
6	501	815	920	799	321	758	704	693	068	605	54
7	57524	81798	58943	80782	60344	79741	61726	78676	63090	77586	53
8	548	781	967	765	367	723	749	658	113	568	52
9	572	765	990	748	390	706	772	640	135	550	51
10	596	748	59014	730	414	688	795	622	158	531	50
11	619	731	037	713	437	671	818	604	180	513	49
12	643	714	061	696	460	653	841	586	203	494	48
13	57667	81698	59084	80679	60483	79635	61864	78568	63225	77476	47
14	691	681	108	662	506	618	887	550	248	458	46
15	715	664	131	644	529	600	909	532	271	439	45
16	738	647	154	627	553	583	932	514	293	421	44
17	762	631	178	610	576	565	955	496	316	402	43
18	786	614	201	593	599	547	978	478	338	384	42
19	57809	81597	59225	80576	60622	79530	62001	78460	63361	77366	41
20	833	580	240	558	645	512	024	442	383	347	40
21	857	563	272	541	668	494	046	424	406	329	39
22	881	546	295	524	691	477	069	405	428	310	38
23	904	530	318	507	714	459	092	387	451	292	37
24	928	513	342	489	738	441	115	369	473	273	36
25	57952	81496	59365	80472	60761	79424	62138	78351	63496	77255	35
26	976	479	389	455	784	406	160	333	518	236	34
27	999	462	412	438	807	388	183	315	540	218	33
28	58023	445	436	420	830	371	206	297	563	199	32
29	047	428	459	403	853	353	229	279	583	181	31
30	070	412	482	386	876	335	251	261	608	162	30
31	58094	81395	59506	80368	60899	79318	62274	78243	63630	77144	29
32	118	378	529	351	922	300	297	225	653	125	28
33	141	361	552	334	945	282	320	206	675	107	27
34	165	344	576	316	968	264	342	188	698	088	26
35	189	327	599	299	991	247	365	170	720	070	25
36	212	310	622	282	61015	229	388	152	742	051	24
37	58236	81293	59646	80264	61038	79211	62411	78134	63765	77033	23
38	260	276	669	247	061	193	433	116	787	014	22
39	283	259	693	230	084	176	456	098	810	76996	21
40	307	242	716	212	107	158	479	079	832	977	20
41	330	225	739	195	130	140	502	061	854	959	19
42	354	208	763	178	153	122	524	043	877	940	18
43	58378	81191	59786	80160	61176	79105	62547	78025	63899	76921	17
44	401	174	809	143	199	087	570	007	922	903	16
45	425	157	832	125	222	069	592	77988	944	884	15
46	449	140	856	108	245	051	615	970	966	866	14
47	472	123	879	091	268	033	638	952	989	847	13
48	496	106	902	073	291	015	660	934	64011	828	12
49	58519	81089	59926	80056	61314	78998	62683	77916	64033	76810	11
50	543	072	949	038	337	980	706	897	056	791	10
51	567	055	972	021	360	962	728	879	078	772	9
52	590	038	995	003	383	944	751	861	100	754	8
53	614	021	60019	79986	406	926	774	843	123	735	7
54	637	004	042	968	429	908	796	824	145	717	6
55	58661	80987	60065	79951	61451	78891	62819	77806	64167	76698	5
56	684	970	089	934	474	873	842	788	190	679	4
57	708	953	112	916	497	855	864	769	212	661	3
58	731	936	135	899	520	837	887	751	234	642	2
59	755	919	158	881	543	819	909	733	256	623	1
60	779	902	181	864	566	801	932	715	279	604	0
M.	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	M.
	54°		53°		52°		51°		50°		

TABLE XXIV. OF NATURAL SINES.

	40°		41°		42°		43°		44°		
M	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	M
0	64279	76604	65606	75471	66913	74314	68200	73135	69466	71934	60
1	301	586	628	452	935	295	221	116	487	914	59
2	323	567	650	433	956	276	242	096	508	894	58
3	346	548	672	414	978	256	264	076	529	873	57
4	368	530	694	395	66999	237	285	056	549	853	56
5	390	511	716	375	67021	217	306	036	570	833	55
6	412	492	738	356	043	198	327	016	591	813	54
7	64435	76473	65759	75337	67064	74178	68349	72996	69612	71792	53
8	457	455	781	318	086	159	370	976	633	772	52
9	479	436	803	299	107	139	391	957	654	752	51
10	501	417	825	280	129	120	412	937	675	732	50
11	524	398	847	261	151	100	433	917	696	711	49
12	546	380	869	241	172	080	455	897	717	691	48
13	64568	76361	65891	75222	67194	74061	68476	72877	69737	71671	47
14	590	342	913	203	215	041	497	857	758	650	46
15	612	323	935	184	237	022	518	837	779	630	45
16	635	304	956	165	258	002	539	817	800	610	44
17	657	286	978	146	280	73983	561	797	821	590	43
18	679	267	66000	126	301	963	582	777	842	569	42
19	64701	76248	66022	75107	67321	73944	68603	72757	69862	71549	41
20	723	229	044	088	344	924	624	737	883	529	40
21	746	210	066	069	366	904	645	717	904	508	39
22	768	192	088	050	387	885	666	697	925	488	38
23	790	173	109	030	409	865	688	677	946	468	37
24	812	154	131	011	430	846	709	657	966	447	36
25	64834	76135	66153	74992	67452	73826	68730	72637	69987	71427	35
26	856	116	175	973	473	806	751	617	70008	407	34
27	878	097	197	953	495	787	772	597	029	386	33
28	901	078	218	934	516	767	793	577	049	366	32
29	923	059	240	915	538	747	814	557	070	345	31
30	945	041	262	896	559	728	835	537	091	325	30
31	6496	76022	66284	74876	67580	73708	68857	72517	70112	71305	29
32	989	003	306	857	602	688	878	497	132	284	28
33	65011	75984	327	838	623	669	899	477	153	264	27
34	033	965	349	818	645	649	920	457	174	243	26
35	055	946	371	799	666	629	941	437	195	223	25
36	077	927	393	780	688	610	962	417	215	203	24
37	65099	75908	66414	74760	67709	73590	68983	72397	70236	71182	23
38	122	889	436	741	730	570	69004	377	257	162	22
39	144	870	458	722	752	551	025	357	277	141	21
40	166	851	480	703	773	531	046	337	298	121	20
41	188	832	501	683	795	511	067	317	319	100	19
42	210	813	523	664	816	491	088	297	339	080	18
43	65232	75794	66545	74644	67837	73472	69109	72277	70360	71059	17
44	254	775	566	625	859	452	130	257	381	039	16
45	276	756	588	606	880	432	151	236	401	019	15
46	298	738	610	586	901	412	172	216	422	70998	14
47	320	719	632	567	923	393	193	196	443	978	13
48	342	699	653	548	944	373	214	176	463	957	12
49	65364	75680	66675	74528	67965	73353	69235	72156	70484	70937	11
50	386	661	697	509	987	333	256	136	505	916	10
51	408	642	718	489	68008	314	277	116	525	896	9
52	430	623	740	470	029	294	298	095	546	875	8
53	452	604	762	451	051	274	319	075	567	855	7
54	474	585	783	431	072	254	340	055	587	834	6
55	65496	75566	66805	74412	68093	73234	69361	72035	70608	70813	5
56	518	547	827	392	115	215	382	015	628	793	4
57	540	528	848	373	136	195	403	71995	649	772	3
58	562	509	870	353	157	175	424	974	670	752	2
59	584	490	891	334	179	155	445	954	690	731	1
60	606	471	913	314	200	135	466	934	711	711	0
M	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	N cos.	N sine	M
	49°		48°		47°		46°		45°		

S.	h m 0° 0′	h m 0° 1′	h m 0° 2′	h m 0° 3′	h m 0° 4′	h m 0° 5′	h m 0° 6′	h m 0° 7′	h m 0° 8′
0½	4.3345	2.2553	1.9542	1.7782	1.6532	1.5563	1.4771	1.4102	1.3522
1	4.0334	2481	9506	7757	6514	5549	4759	4091	3513
2	3.7324	2410	9471	7734	6496	5534	4747	4081	3504
3	3.5563	2341	9435	7710	6478	5520	4735	4071	3495
4	3.4314	2272	9400	7686	6460	5506	4723	4061	3486
5	3.3345	2205	9365	7663	6443	5491	4711	4050	3477
6	3.2553	2139	9331	7639	6425	5477	4699	4040	3468
7	3.1883	2073	9296	7616	6407	5463	4688	4030	3459
8	3.1303	2009	9262	7593	6390	5449	4676	4020	3450
9	3.0792	1946	9228	7570	6372	5435	4664	4010	3441
10	3.0334	2.1883	1.9195	1.7547	1.6355	1.5421	1.4652	1.4000	1.3432
11	2.9920	1822	9162	7524	6338	5407	4640	3989	3423
12	9542	1761	9128	7501	6320	5393	4629	3979	3415
13	9195	1701	9096	7479	6303	5379	4617	3969	3406
14	8873	1642	9063	7456	6286	5365	4606	3959	3397
15	8573	1584	9031	7434	6269	5351	4594	3949	3388
16	8293	1526	8999	7412	6252	5337	4582	3939	3379
17	8030	1469	8967	7390	6255	5324	4571	3929	3371
18	7782	1413	8935	7368	6218	5310	4559	3919	3362
19	7547	1358	8904	7346	6201	5296	4548	3910	3353
20	2.7324	2.1303	1.8873	1.7324	1.6185	1.5283	1.4536	1.3900	1.3345
21	7112	1249	8842	7302	6168	5269	4525	3890	3336
22	6910	1196	8811	7281	6151	5256	4514	3880	3327
23	6717	1143	8781	7259	6135	5242	4502	3870	3319
24	6532	1091	8751	7238	6118	5229	4491	3860	3310
25	6355	1040	8721	7217	6102	5215	4480	3851	3301
26	6105	0989	8691	7196	6085	5202	4468	3841	3293
27	6021	0939	8661	7175	6069	5189	4457	3831	3284
28	5863	0889	8632	7154	6053	5175	4446	3821	3276
29	5710	0840	8602	7136	6037	5166	4435	3812	3267
30	2.5563	2.0792	1.8573	1.7112	1.6021	1.5149	1.4424	1.3802	1.3259
31	5421	0744	8544	7091	6005	5136	4412	3792	3250
32	5283	0696	8516	7071	5989	5123	4401	3783	3242
33	5149	0649	8487	7050	5973	5110	4390	3773	3233
34	5019	0603	8459	7030	5957	5097	4379	3764	3225
35	4894	0557	8431	7010	5941	5084	4368	3754	3216
36	4771	0512	8403	6990	5925	5071	4357	3745	3208
37	4652	0467	8375	6970	5909	5058	4346	3735	3199
38	4536	0422	8348	6950	5894	5045	4335	3726	3191
39	4424	0378	8320	6930	5878	5032	4325	3716	3183
40	2.4314	2.0334	1.8293	1.6910	1.5863	1.5019	1.4314	1.3707	1.3174
41	4206	0291	8266	6890	5847	5007	4303	3697	3166
42	4102	0248	8239	6871	5832	4994	4292	3688	3158
43	4000	0206	8212	6851	5816	4981	4281	3678	3149
44	3900	0164	8186	6832	5801	4969	4270	3669	3141
45	3802	0122	8159	6812	5786	4956	4260	3660	3133
46	3707	0081	8133	6793	5771	4943	4249	3650	3124
47	3613	0040	8107	6774	5755	4931	4238	3641	3116
48	3522	0000	8081	6755	5740	4918	4228	3632	3108
49	3432	1.9960	8055	6736	5725	4906	4217	3623	3100
50	2.3345	1.9920	1.8030	1.6717	1.5710	1.4894	1.4206	1.3613	1.3091
51	3259	9881	8004	6698	5695	4881	4196	3604	3083
52	3174	9842	7979	6679	5680	4869	4185	3595	3075
53	3091	9803	7954	6661	5666	4856	4175	3586	3067
54	3010	9765	7929	6642	5651	4844	4164	3576	3059
55	2931	9727	7904	6624	5636	4832	4154	3567	3051
56	2852	9690	7879	6605	5621	4820	4143	3558	3043
57	2775	9652	7855	6587	5607	4808	4133	3549	3034
58	2700	9615	7830	6568	5592	4795	4122	3540	3026
59	2626	9579	7806	6550	5578	4783	4112	3531	3118
60	2.2553	1.9542	1.7782	1.6532	1.5563	1.4771	1.4102	1.3522	1.3010
S.	h m 0° 0′	h m 0° 1′	h m 0° 2′	h m 0° 3′	h m 0° 4′	h m 0° 5′	h m 0° 6′	h m 0° 7′	h m 0° 8′

S.	h m 0° 9′	h m 0° 10′	h m 0° 11′	h m 0° 12′	h m 0° 13′	h m 0° 14′	h m 0° 15′	h m 0° 16′	h m 0° 17′
0	1.3010	1.2553	1.2139	1.1761	1.1413	1.1091	1.0792	1.0512	1.0248
1	3002	2545	2132	1755	1408	1086	0787	0507	0244
2	2994	2538	2126	1749	1402	1081	0782	0502	0240
3	2986	2531	2119	1743	1397	1076	0777	0498	0235
4	2978	2524	2113	1737	1391	1071	0773	0493	0231
5	2970	2517	2106	1731	1386	1066	0768	0489	0227
6	2962	2510	2099	1725	1380	1061	0763	0484	0224
7	2954	2502	2093	1719	1374	1055	0758	0480	0219
8	2946	2495	2086	1713	1369	1050	0753	0475	0214
9	2939	2488	2080	1707	1363	1045	0749	0471	0210
10	1.2931	1.2481	1.2073	1.1701	1.1358	1.1040	1.0744	1.0467	1.0206
11	2923	2474	2067	1695	1352	1035	0739	0462	0202
12	2915	2467	2061	1689	1347	1030	0734	0458	0197
13	2907	2460	2054	1683	1342	1025	0730	0453	0193
14	2899	2453	2048	1677	1336	1020	0725	0449	0189
15	2891	2445	2041	1671	1331	1015	0720	0444	0185
16	2883	2438	2035	1665	1325	1009	0715	0440	0181
17	2876	2431	2028	1660	1320	1004	0711	0435	0176
18	2868	2424	2022	1654	1314	0999	0706	0431	0172
19	2860	2417	2016	1648	1309	0994	0701	0426	0168
20	1.2852	1.2410	1.2009	1.1642	1.1303	1.0989	1.0696	1.0422	1.0164
21	2845	2403	2003	1636	1298	0984	0692	0418	0160
22	2837	2396	1996	1630	1292	0979	0687	0413	0156
23	2829	2389	1990	1624	1287	0974	0682	0409	0151
24	2821	2382	1984	1619	1282	0969	0678	0404	0147
25	2814	2375	1977	1613	1276	0964	0673	0400	0143
26	2806	2368	1971	1607	1271	0959	0668	0395	0139
27	2798	2362	1965	1601	1266	0954	0663	0391	0135
28	2791	2355	1958	1595	1260	0949	0659	0387	0131
29	2783	2348	1952	1589	1255	0944	0654	0382	0126
30	1.2775	1.2341	1.1946	1.1584	1.1249	1.0939	1.0649	1.0378	1.0122
31	2768	2334	1939	1578	1244	0934	0645	0374	0118
32	2760	2327	1933	1572	1239	0929	0640	0369	0114
33	2753	2320	1927	1566	1233	0924	0635	0365	0110
34	2745	2313	1921	1561	1228	0919	9631	0360	0106
35	2738	2307	1914	1555	1223	0914	0626	0356	0102
36	2730	2300	1908	1549	1217	0909	0621	0352	0098
37	2722	2293	1902	1543	1212	0904	0617	0347	0093
38	2715	2286	1896	1538	1207	0899	0612	0343	0089
39	2707	2279	1889	1532	1201	0894	0608	0339	0085
40	1.2700	1.2272	1.1883	1.1526	1.1196	1.0889	1.0603	1.0334	1.0081
41	2692	2266	1877	1520	1191	0884	0598	0330	0077
42	2685	2259	1871	1515	1186	0880	0594	0326	0073
43	2678	2252	1865	1509	1180	0875	0589	0321	0069
44	2670	2245	1858	1503	1175	0870	0585	0317	0065
45	2663	2239	1852	1498	1170	0865	0580	0313	0061
46	2655	2232	1846	1492	1164	0860	0575	0308	0057
47	2648	2225	1840	1486	1159	0855	0571	0304	0053
48	2640	2218	1834	1481	1154	0850	0566	0300	0049
49	2633	2212	1828	1475	1149	0845	0562	0295	0044
50	1.2626	1.2205	1.1822	1.1469	1.1143	1.0840	1.0557	1.0291	1.0040
51	2618	2198	1816	1464	1138	0835	0552	0287	0036
52	2611	2192	1809	1458	1133	0831	0548	0282	0032
53	2604	2185	1803	1452	1128	0826	0543	0278	0028
54	2596	2178	1797	1447	1123	0821	0539	0274	0024
55	2589	2172	1791	1441	1117	0816	0534	0270	0020
56	2582	2165	1785	1436	1112	0811	0530	0265	0016
57	2574	2159	1779	1430	1107	0806	0525	0261	0012
58	2567	2152	1773	1424	1102	0801	0520	0257	0008
59	2560	2145	1767	1419	1097	0797	0516	0252	0004
60	1.2553	1.2139	1.1761	1.1413	1.1091	1.0792	1.0512	1.0248	1.0000
S.	h m 0° 9′	h m 0° 10′	h m 0° 11′	h m 0° 12′	h m 0° 13′	h m 0° 14′	h m 0° 15′	h m 0° 16′	h m 0° 17′

M	h m 0° 18'	h m 0° 19'	h m 0° 20'	h m 0° 21'	h m 0° 22'	h m 0° 23'	h m 0° 24'	h m 0° 25'	h m 0° 26'	h m 0° 27'	h m 0° 28'	h m 0° 29'
0	10000	9765	9542	9331	9128	8935	8751	8572	8403	8239	8081	7929
1	9996	9761	9538	9327	9125	8932	8748	8570	8400	8236	8079	7926
2	9992	9758	9535	9324	9122	8929	8745	8568	8397	8234	8076	7924
3	9988	9754	9532	9320	9119	8926	8742	8565	8395	8231	8073	7921
4	9984	9750	9528	9317	9115	8923	8739	8562	8392	8228	8071	7919
5	9980	9746	9524	9313	9112	8920	8736	8559	8389	8226	8068	7916
6	9976	9742	9521	9310	9109	8917	8733	8556	8386	8223	8066	7914
7	9972	9739	9517	9306	9106	8913	8730	8553	8384	8220	8063	7911
8	9968	9735	9514	9303	9102	8910	8727	8550	8381	8218	8061	7909
9	9964	9731	9510	9300	9099	8907	8724	8547	8378	8215	8058	7906
10	9960	9727	9506	9296	9096	8904	8721	8544	8375	8212	8055	7904
11	9956	9723	9503	9293	9092	8901	8718	8542	8372	8210	8053	7901
12	9952	9720	9499	9289	9089	8898	8715	8539	8370	8207	8050	7899
13	9948	9716	9496	9286	9086	8895	8712	8536	8367	8204	8048	7896
14	9944	9712	9492	9283	9083	8892	8709	8533	8364	8202	8045	7894
15	9940	9708	9488	9279	9079	8888	8706	8530	8361	8199	8043	7891
16	9936	9705	9485	9276	9076	8885	8703	8527	8359	8196	8040	7889
17	9932	9701	9481	9272	9073	8882	8700	8524	8356	8194	8037	7887
18	9928	9697	9478	9269	9070	8879	8697	8522	8353	8191	8035	7884
19	9924	9693	9474	9266	9066	8876	8694	8519	8350	8188	8032	7882
20	9920	9690	9471	9262	9063	8873	8691	8516	8348	8186	8030	7879
21	9916	9686	9467	9259	9060	8870	8688	8513	8345	8183	8027	7877
22	9912	9682	9464	9255	9057	8867	8685	8510	8342	8181	8025	7874
23	9908	9678	9460	9252	9053	8864	8682	8507	8339	8178	8022	7872
24	9905	9675	9456	9249	9050	8861	8679	8504	8337	8175	8020	7869
25	9901	9671	9453	9245	9047	8857	8676	8502	8334	8173	8017	7867
26	9897	9667	9449	9242	9044	8854	8673	8499	8331	8170	8014	7864
27	9893	9664	9446	9238	9041	8851	8670	8496	8328	8167	8012	7862
28	9889	9660	9442	9235	9037	8848	8667	8493	8326	8165	8009	7859
29	9885	9656	9439	9232	9034	8845	8664	8490	8323	8162	8007	7857
30	9881	9652	9435	9228	9031	8842	8661	8487	8320	8159	8004	7855
31	9877	9649	9431	9225	9028	8839	8658	8484	8318	8157	8002	7852
32	9873	9645	9428	9222	9024	8836	8655	8482	8315	8154	7999	7850
33	9869	9641	9425	9218	9021	8833	8652	8479	8312	8152	7997	7847
34	9865	9638	9421	9215	9018	8830	8649	8476	8309	8149	7994	7845
35	9861	9634	9418	9212	9015	8827	8646	8473	8307	8146	7992	7842
36	9858	9630	9414	9208	9012	8824	8643	8470	8304	8144	7989	7840
37	9854	9626	9411	9205	9008	8821	8640	8467	8301	8141	7987	7837
38	9850	9623	9407	9201	9005	8817	8637	8465	8298	8138	7984	7835
39	9846	9619	9404	9198	9002	8814	8635	8462	8296	8136	7981	7832
40	9842	9615	9400	9195	8999	8811	8632	8459	8293	8133	7979	7830
41	9838	9612	9397	9191	8996	8808	8629	8456	8290	8131	7976	7828
42	9834	9608	9393	9188	8992	8805	8626	8453	8288	8128	7974	7825
43	9830	9604	9390	9185	8989	8802	8623	8451	8285	8125	7971	7823
44	9827	9601	9386	9181	8986	8799	8620	8448	8282	8123	7969	7820
45	9823	9597	9383	9178	8983	8796	8617	8445	8279	8120	7966	7818
46	9819	9593	9379	9175	8980	8793	8614	8442	8277	8117	7964	7815
47	9815	9590	9376	9172	8977	8790	8611	8439	8274	8115	7961	7813
48	9811	9586	9372	9168	8973	8787	8608	8437	8271	8112	7959	7811
49	9807	9582	9369	9165	8970	8784	8605	8434	8269	8110	7956	7808
50	9803	9579	9365	9162	8967	8781	8602	8431	8266	8107	7954	7806
51	9800	9575	9362	9158	8964	8778	8599	8428	8263	8104	7951	7803
52	9796	9571	9358	9155	8961	8775	8597	8425	8261	8102	7949	7801
53	9792	9568	9355	9152	8958	8772	8594	8423	8258	8099	7946	7798
54	9788	9564	9351	9148	8954	8769	8591	8420	8255	8097	7944	7796
55	9784	9561	9348	9145	8951	8766	8588	8417	8253	8094	7941	7794
56	9780	9557	9344	9142	8948	8763	8585	8414	8250	8091	7939	7791
57	9777	9553	9341	9138	8945	8760	8582	8411	8247	8089	7936	7789
58	9773	9550	9337	9135	8942	8757	8579	8409	8244	8086	7934	7786
59	9769	9546	9334	9132	8939	8754	8576	8406	8242	8084	7931	7784
60	9765	9542	9331	9128	8935	8751	8572	8403	8239	8081	7929	7782
S.	h m 0° 18'	h m 0° 19'	h m 0° 20'	h m 0° 21'	h m 0° 22'	h m 0° 23'	h m 0° 24'	h m 0° 25'	h m 0° 26'	h m 0° 27'	h m 0° 28'	h m 0° 29'

TABLE XXV. PROPORTIONAL LOGARITHMS.

S	h m 0° 30′	h m 0° 31′	h m 0° 32′	h m 0° 33′	h m 0° 34′	h m 0° 35′	h m 0° 36′	h m 0° 37′	h m 0° 38′	h m 0° 39′	h m 0° 40′	h m 0° 41′
0	7782	7639	7501	7368	7238	7112	6990	6871	6755	6642	6532	6425
1	7779	7637	7499	7365	7236	7110	6988	6869	6753	6640	6530	6423
2	7777	7634	7497	7363	7234	7108	6986	6867	6751	6638	6529	6421
3	7774	7632	7494	7361	7232	7106	6984	6865	6749	6637	6527	6420
4	7772	7630	7492	7359	7229	7104	6982	6863	6747	6635	6525	6418
5	7769	7627	7490	7357	7227	7102	6980	6861	6745	6633	6523	6416
6	7767	7625	7488	7354	7225	7100	6978	6859	6743	6631	6521	6414
7	7765	7623	7485	7352	7223	7098	6976	6857	6742	6629	6519	6413
8	7762	7620	7483	7350	7221	7096	6974	6855	6740	6627	6518	6411
9	7760	7618	7481	7348	7219	7093	6972	6853	6738	6625	6516	6409
10	7757	7616	7479	7346	7217	7091	6970	6851	6736	6624	6514	6407
11	7755	7613	7476	7344	7215	7089	6968	6849	6734	6622	6512	6406
12	7753	7611	7474	7341	7212	7087	6966	6847	6732	6620	6510	6404
13	7750	7609	7472	7339	7110	7085	6964	6845	6730	6618	6509	6402
14	7748	7607	7470	7337	7208	7083	6962	6843	6728	6616	6507	6400
15	7746	7604	7467	7335	7206	7081	6960	6841	6726	6614	6505	6398
16	7743	7602	7465	7333	7204	7079	6958	6840	6725	6612	6503	6397
17	7741	7600	7463	7330	7202	7077	6956	6838	6723	6611	6501	6395
18	7738	7597	7461	7328	7200	7075	6954	6836	6721	6609	6500	6393
19	7736	7595	7458	7326	7198	7073	6952	6834	6719	6607	6498	6391
20	7734	7593	7456	7324	7196	7071	6950	6832	6717	6605	6496	6390
21	7731	7590	7454	7122	7193	7069	6948	6830	6715	6603	6494	6388
22	7729	7588	7452	7320	7191	7067	6946	6828	6713	6601	6492	6386
23	7726	7586	7450	7317	7189	7065	6944	6826	6711	6600	6491	6384
24	7724	7583	7447	7315	7187	7003	6942	6824	6709	6598	6489	6383
25	7722	7581	7445	7313	7185	7061	6940	6822	6708	6596	6487	6381
26	7719	7579	7443	7311	7183	7059	6938	6320	6706	6594	6485	6379
27	7717	7577	7441	7309	7181	7057	6936	6818	6704	6592	6484	6377
28	7714	7574	7438	7307	7179	7055	6934	6816	6702	6590	6482	6376
29	7712	7572	7436	7304	7177	7052	6932	6814	6700	6589	6480	6374
30	7710	7570	7434	7302	7175	7050	6930	6812	6698	6587	6478	6372
31	7707	7567	7432	7300	7172	7048	6928	6810	6696	6585	6476	6371
32	7705	7565	7429	7298	7170	7046	6926	6809	6694	6583	6475	6369
33	7703	7563	7427	7296	7168	7044	6924	6807	6692	6581	6473	6367
34	7700	7560	7425	7294	7166	7042	6922	6805	6691	6579	6471	6365
35	7698	7558	7423	7291	7164	7040	6920	6803	6689	6578	6469	6364
36	7696	7556	7421	7289	7162	7038	6918	6801	6687	6576	6467	6362
37	7693	7554	7418	7287	7160	7036	6916	6799	6685	6574	6466	6360
38	7691	7551	7416	7285	7158	7034	6914	6797	6683	6572	6464	6358
39	7688	7549	7414	7283	7156	7032	6912	6795	6681	6570	6462	6357
40	7686	7547	7412	7281	7154	7030	6910	6793	6679	6568	6460	6355
41	7684	7544	7409	7279	7152	7028	6908	6791	6677	6567	6459	6353
42	7681	7542	7407	7276	7149	7026	6906	6789	6676	6565	6457	6351
43	7679	7540	7405	7274	7147	7024	6904	6787	6674	6563	6455	6350
44	7677	7538	7403	7172	7145	7022	6902	6785	6672	6561	6453	6348
45	7674	7535	7401	7270	7143	7020	6900	6784	6670	6559	6451	6346
46	7672	7533	7398	7268	7141	7018	6898	6782	6668	6558	6450	6344
47	7670	7531	7396	7266	7139	7016	6896	6780	6666	6556	6448	6343
48	7667	7528	7394	7264	7137	7014	6894	6778	6664	6554	6446	6341
49	7665	7526	7392	7261	7135	7012	6892	6776	6663	6552	6444	6339
50	7663	7524	7390	7259	7133	7010	6890	6774	6661	6550	6443	6338
51	7660	7522	7387	7257	7131	7008	6888	6772	6659	6548	6441	6336
52	7658	7519	7385	7255	7129	7006	6886	6770	6657	6547	6439	6334
53	7655	7517	7383	7253	7127	7004	6884	6768	6655	6545	6437	6332
54	7653	7515	7381	7251	7124	7002	6882	6766	6653	6543	6435	6331
55	7651	7513	7379	7249	7122	7000	6881	6764	6651	6541	6434	6329
56	7648	7510	7376	7246	7120	6998	6879	6763	6650	6539	6432	6327
57	7646	7508	7374	7244	7118	6996	6877	6761	6648	6538	6430	6325
58	7644	7505	7372	7242	7116	6994	6875	6759	6646	6536	6428	6324
59	7641	7503	7370	7240	7114	6992	6873	6757	6644	6534	6427	6322
60	7639	7501	7368	7238	7112	6990	6871	6755	6642	6532	6425	6320
S	h m 0° 30′	h m 0° 31′	h m 0° 32′	h m 0° 33′	h m 0° 34′	h m 0° 35′	h m 0° 36′	h m 0° 37′	h m 0° 38′	h m 0° 39′	h m 0° 40′	h m 0° 41′

S.	h m 0° 42′	h m 0° 43′	h m 0° 44′	h m 0° 45′	h m 0° 46′	h m 0° 47′	h m 0° 48′	h m 0° 49′	h m 0° 50′	h m 0° 51′	h m 0° 52′	h m 0° 53′
0	6320	6218	6118	6021	5925	5832	5740	5651	5563	5477	5393	5310
1	6319	6216	6117	6019	5924	5830	5739	5649	5562	5476	5391	5309
2	6317	6215	6115	6017	5922	5829	5737	5648	5560	5474	5390	5307
3	6315	6213	6113	6016	5920	5827	5736	5646	5559	5473	5389	5306
4	6313	6211	6112	6014	5919	5826	5734	5645	5557	5471	5387	5305
5	6312	6210	6110	6013	5917	5824	5733	5643	5556	5470	5386	5303
6	6310	6208	6108	6011	5916	5822	5731	5642	5554	5469	5384	5302
7	6308	6206	6107	6009	5914	5821	5730	5640	5553	5467	5383	5300
8	6306	6205	6105	6008	5913	5819	5728	5639	5551	5466	5382	5299
9	6305	6203	6103	6006	5911	5818	5727	5637	5550	5464	5380	5298
10	6303	6201	6102	6005	5909	5816	5725	5636	5549	5463	5379	5296
11	6301	6200	6100	6003	5908	5815	5724	5635	5547	5461	5377	5295
12	6300	6198	6099	6001	5906	5813	5722	5633	5546	5460	5376	5294
13	6298	6196	6097	6000	5905	5812	5721	5632	5544	5459	5375	5292
14	6296	6195	6095	5998	5903	5810	5719	5630	5543	5457	5373	5291
15	6294	6193	6094	5997	5902	5809	5718	5629	5541	5456	5372	5290
16	6293	6191	6092	5995	5900	5807	5716	5627	5540	5454	5370	5288
17	6291	6190	6090	5993	5898	5806	5715	5626	5538	5453	5369	5287
18	6289	6188	6089	5992	5897	5804	5713	5624	5537	5452	5368	5285
19	6288	6186	6087	5990	5895	5803	5712	5623	5536	5450	5366	5284
20	6286	6185	6085	5989	5894	5801	5710	5621	5534	5449	5365	5283
21	6284	6183	6084	5987	5892	5800	5709	5620	5533	5447	5364	5281
22	6282	6181	6082	5985	5891	5798	5707	5618	5531	5446	5362	5280
23	6281	6179	6081	5984	5889	5796	5706	5617	5530	5444	5361	5279
24	6279	6178	6079	5982	5888	5795	5704	5615	5528	5443	5359	5277
25	6277	6176	6077	5981	5886	5793	5703	5614	5527	5442	5358	5276
26	6276	6174	6076	5979	5884	5792	5701	5613	5526	5440	5357	5275
27	6274	6173	6074	5977	5883	5790	5700	5611	5524	5439	5355	5273
28	6272	6171	6072	5976	5881	5789	5698	5610	5523	5437	5354	5272
29	6271	6169	6071	5974	5880	5787	5697	5608	5521	5436	5353	5271
30	6269	6168	6069	5973	5878	5786	5695	5607	5520	5435	5351	5269
31	6267	6166	6067	5971	5877	5784	5694	5605	5518	5433	5350	5268
32	6265	6165	6066	5969	5875	5783	5692	5604	5517	5432	5348	5266
33	6264	6163	6064	5968	5874	5781	5691	5602	5516	5430	5347	5265
34	6262	6161	6063	5966	5872	5780	5689	5601	5514	5429	5346	5264
35	6260	6160	6061	5965	5870	5778	5688	5599	5513	5428	5344	5262
36	6259	6158	6059	5963	5869	5777	5686	5598	5511	5426	5343	5261
37	6257	6156	6058	5961	5867	5775	5685	5596	5510	5425	5341	5260
38	6255	6155	6056	5960	5866	5774	5683	5595	5508	5423	5340	5258
39	6254	6153	6055	5958	5864	5772	5682	5594	5507	5422	5339	5257
40	6252	6151	6053	5957	5863	5771	5680	5592	5506	5421	5337	5256
41	6250	6150	6051	5955	5861	5769	5679	5591	5504	5419	5336	5254
42	6248	6148	6050	5954	5860	5768	5677	5589	5503	5418	5335	5253
43	6247	6146	6048	5952	5858	5766	5676	5588	5501	5416	5333	5252
44	6245	6145	6046	5950	5856	5765	5674	5586	5500	5415	5332	5250
45	6243	6143	6045	5949	5855	5763	5673	5585	5498	5414	5331	5249
46	6242	6141	6043	5947	5853	5761	5671	5583	5497	5412	5329	5248
47	6240	6140	6042	5946	5852	5760	5670	5582	5496	5411	5328	5246
48	6238	6138	6040	5944	5850	5758	5669	5580	5494	5409	5326	5245
49	6237	6136	6038	5942	5849	5757	5667	5579	5493	5408	5325	5244
50	6235	6135	6037	5941	5847	5755	5666	5578	5491	5407	5324	5242
51	6233	6133	6035	5939	5846	5754	5664	5576	5490	5405	5322	5241
52	6232	6131	6033	5938	5844	5752	5663	5575	5488	5404	5321	5240
53	6230	6130	6032	5936	5843	5751	5661	5573	5487	5402	5320	5238
54	6228	6128	6030	5935	5841	5749	5660	5572	5486	5401	5318	5237
55	6226	6126	6029	5933	5839	5748	5658	5570	5484	5400	5317	5235
56	6225	6125	6027	5931	5838	5746	5657	5569	5483	5398	5315	5234
57	6223	6123	6025	5930	5836	5745	5655	5567	5481	5397	5314	5233
58	6221	6121	6024	5928	5835	5743	5654	5566	5480	5395	5313	5231
59	6220	6120	6022	5927	5833	5742	5652	5564	5478	5394	5311	5230
60	6218	6118	6021	5925	5832	5740	5651	5563	5477	5393	5310	5229
S.	h m 0° 42′	h m 0° 43′	h m 0° 44′	h m 0° 45′	h m 0° 46′	h m 0° 47′	h m 0° 48′	h m 0° 49′	h m 0° 50′	h m 0° 51′	h m 0° 52′	h m 0° 53′

S.	h m 0° 54′	h m 0° 55′	h m 0° 56′	h m 0° 57′	h m 0° 58′	h m 0° 59′	h m 1° 0′	h m 1° 1′	h m 1° 2′	h m 1° 3′	h m 1° 4′	h m 1° 5′
0	5229	5149	5071	4994	4918	4844	4771	4690	4629	4559	4491	4424
1	5227	5148	5070	4993	4917	4843	4770	4698	4628	4558	4490	4422
2	5226	5146	5068	4991	4916	4842	4769	4697	4626	4557	4489	4421
3	5225	5145	5067	4990	4915	4841	4768	4696	4625	4556	4488	4420
4	5223	5144	5066	4989	4913	4839	4766	4695	4624	4555	4486	4419
5	5222	5143	5064	4988	4912	4838	4765	4693	4623	4554	4485	4418
6	5221	5141	5063	4986	4911	4837	4764	4692	4622	4552	4484	4417
7	5219	5140	5062	4985	4910	4836	4763	4691	4621	4551	4483	4416
8	5218	5139	5061	4984	4908	4834	4762	4690	4619	4550	4482	4415
9	5217	5137	5059	4983	4907	4833	4760	4689	4618	4549	4481	4414
10	5215	5136	5058	4981	4906	4832	4759	4688	4617	4548	4480	4412
11	5214	5135	5057	4980	4905	4831	4758	4686	4616	4547	4479	4411
12	5213	5133	5055	4979	4903	4830	4757	4685	4615	4546	4477	4410
13	5211	5132	5054	4977	4902	4828	4756	4684	4614	4544	4476	4409
14	5210	5131	5053	4976	4901	4827	4754	4683	4612	4543	4475	4408
15	5209	5129	5051	4975	4900	4826	4753	4682	4611	4542	4474	4407
16	5207	5128	5050	4974	4899	4825	4752	4680	4610	4541	4473	4406
17	5206	5127	5049	4972	4897	4823	4751	4679	4609	4540	4472	4405
18	5205	5125	5048	4971	4896	4822	4750	4678	4608	4539	4471	4404
19	5203	5124	5046	4970	4895	4821	4748	4677	4607	4538	4469	4402
20	5202	5123	5045	4969	4894	4820	4747	4676	4606	4536	4468	4401
21	5201	5122	5044	4967	4892	4819	4746	4675	4604	4535	4467	4400
22	5199	5120	5043	4966	4891	4817	4745	4673	4603	4534	4466	4399
23	5198	5119	5041	4965	4890	4816	4744	4672	4602	4533	4465	4398
24	5197	5118	5040	4964	4889	4815	4742	4671	4601	4532	4464	4397
25	5195	5116	5039	4962	4887	4814	4741	4670	4600	4531	4463	4396
26	5194	5115	5037	4961	4886	4812	4740	4669	4599	4530	4462	4395
27	5193	5114	5036	4960	4885	4811	4739	4668	4597	4528	4460	4394
28	5191	5112	5035	4959	4884	4810	4738	4666	4596	4527	4459	4393
29	5190	5111	5034	4957	4882	4809	4736	4665	4595	4526	4458	4391
30	5189	5110	5032	4956	4881	4808	4735	4664	4594	4525	4457	4390
31	5187	5108	5031	4955	4880	4806	4734	4663	4593	4524	4456	4389
32	5186	5107	5030	4954	4879	4805	4733	4662	4592	4523	4455	4388
33	5185	5106	5028	4952	4877	4804	4732	4660	4590	4522	4454	4387
34	5183	5105	5027	4951	4876	4803	4730	4659	4589	4520	4453	4386
35	5182	5103	5026	4950	4875	4801	4729	4658	4588	4519	4452	4385
36	5181	5102	5025	4949	4874	4800	4728	4657	4587	4518	4450	4384
37	5179	5101	5023	4947	4873	4799	4727	4656	4586	4517	4449	4383
38	5178	5099	5022	4946	4871	4798	4726	4655	4585	4516	4448	4381
39	5177	5098	5021	4945	4870	4797	4724	4653	4584	4515	4447	4380
40	5175	5097	5019	4943	4869	4795	4723	4752	4582	4514	4446	4379
41	5174	5095	5018	4942	4868	4794	4722	4651	4581	4512	4445	4378
42	5173	5094	5017	4941	4866	4793	4721	4650	4580	4511	4444	4377
43	5172	5093	5016	4940	4865	4792	4720	4649	4579	4510	4443	4376
44	5170	5092	5014	4938	4864	4791	4718	4648	4578	4509	4441	4375
45	5169	5090	5013	4937	4863	4789	4717	4646	4577	4508	4440	4374
46	5168	5089	5012	4936	4861	4788	4716	4645	4575	4507	4439	4373
47	5166	5088	5011	4935	4860	4787	4715	4644	4574	4506	4438	4372
48	5165	5086	5009	4933	4859	4786	4714	4643	4573	4505	4437	4370
49	5164	5085	5008	4932	4858	4784	4712	4642	4572	4503	4436	4369
50	5162	5084	5007	4931	4856	4783	4711	4640	4571	4502	4435	4368
51	5161	5082	5005	4930	4855	4782	4710	4639	4570	4501	4434	4367
52	5160	5081	5004	4928	4854	4781	4706	4638	4569	4500	4433	4366
53	5158	5080	5003	4927	4853	4780	4708	4637	4567	4499	4431	4365
54	5157	5079	5002	4926	4852	4778	4707	4636	4566	4498	4430	4364
55	5156	5077	5000	4925	4850	4777	4705	4635	4565	4497	4429	4363
56	5154	5076	4999	4923	4849	4776	4704	4633	4564	4495	4428	4362
57	5153	5075	4998	4922	4848	4775	4703	4632	4563	4494	4427	4361
58	5152	5073	4997	4921	4847	4774	4702	4631	4562	4493	4426	4359
59	5150	5072	4995	4920	4845	4772	4701	4630	4560	4492	4425	4358
60	5149	5071	4994	4918	4844	4771	4699	4692	4559	4491	4424	4357
S.	h m 0° 54′	h m 0° 55′	h m 0° 56′	h m 0° 57′	h m 0° 58′	h m 0° 59′	h m 1° 0′	h m 1° 1′	h m 1° 2′	h m 1° 3′	h m 1° 4′	h m 1° 5′

TABLE XXV. PROPORTIONAL LOGARITHMS.

S	h m 1° 6′	h m 1° 7′	h m 1° 8′	h m 1° 9′	h m 1° 10′	h m 1° 11′	h m 1° 12′	h m 1° 13′	h m 1° 14′	h m 1° 15′	h m 1° 16′	h m 1° 17′
0	4357	4292	4228	4164	4102	4040	3979	3919	3860	3802	3745	3688
1	4356	4291	4227	4163	4101	4039	3978	3919	3859	3801	3744	3687
2	4355	4290	4226	4162	4100	4038	3977	3918	3858	3800	3743	3686
3	4354	4289	4224	4161	4099	4037	3976	3917	3857	3799	3742	3685
4	4353	4288	4223	4160	4098	4036	3975	3916	3856	3798	3741	3684
5	4352	4287	4222	4159	4097	4035	3974	3915	3856	3797	3740	3683
6	4351	4285	4221	4158	4096	4034	3973	3914	3855	3796	3739	3682
7	4350	4284	4220	4157	4095	4033	3972	3913	3854	3795	3738	3681
8	4349	4283	4219	4156	4093	4032	3971	3912	3853	3794	3737	3680
9	4347	4282	4218	4155	4092	4031	3970	3911	3852	3793	3736	3679
10	4346	4281	4217	4154	4091	4030	3969	3910	3851	3792	3735	3678
11	4345	4280	4216	4153	4090	4029	3968	3909	3850	3792	3734	3677
12	4344	4279	4215	4152	4089	4028	3967	3908	3849	3791	3733	3677
13	4343	4278	4214	4151	4088	4027	3966	3907	3848	3790	3732	3676
14	4342	4277	4213	4150	4087	4026	3965	3906	3847	3789	3731	3675
15	4341	4276	4212	4149	4086	4025	3964	3905	3846	3788	3730	3674
16	4340	4275	4211	4147	4085	4024	3963	3904	3845	3787	3729	3673
17	4339	4274	4210	4146	4084	4023	3962	3903	3844	3786	3728	3672
18	4338	4273	4209	4145	4083	4022	3961	3902	3843	3785	3727	3671
19	4336	4271	4207	4144	4082	4021	3960	3901	3842	3784	3727	3670
20	4335	4270	4206	4143	4081	4020	3959	3900	3841	3783	3726	3669
21	4334	4269	4205	4142	4080	4019	3958	3899	3840	3782	3725	3668
22	4333	4268	4204	4141	4079	4018	3957	3898	3839	3781	3724	3667
23	4332	4267	4203	4140	4078	4017	3956	3897	3838	3780	3723	3666
24	4331	4266	4202	4139	4077	4016	3955	3896	3837	3779	3722	3665
25	4330	4265	4201	4138	4076	4015	3954	3895	3836	3778	3721	3664
26	4329	4264	4200	4137	4075	4014	3953	3894	3835	3777	3720	3663
27	4328	4263	4199	4136	4074	4013	3952	3893	3834	3776	3719	3663
28	4327	4262	4198	4135	4073	4012	3951	3892	3833	3775	3718	3662
29	4326	4261	4197	4134	4072	4011	3950	3891	3832	3774	3717	3661
30	4325	4260	4196	4133	4071	4010	3949	3890	3831	3773	3716	3660
31	4323	4259	4195	4132	4070	4009	3948	3889	3830	3772	3715	3659
32	4322	4258	4194	4131	4069	4008	3947	3888	3829	3771	3714	3658
33	4321	4256	4193	4130	4068	4007	3946	3887	3828	3770	3713	3657
34	4320	4255	4192	4129	4067	4006	3945	3886	3827	3769	3712	3656
35	4319	4254	4191	4128	4066	4005	3944	3885	3826	3768	3711	3655
36	4318	4253	4189	4127	4065	4004	3943	3884	3825	3768	3710	3654
37	4317	4252	4188	4126	4064	4003	3942	3883	3824	3767	3709	3653
38	4316	4251	4187	4125	4063	4002	3941	3882	3823	3766	3708	3652
39	4315	4250	4186	4124	4062	4001	3940	3881	3822	3765	3708	3651
40	4314	4249	4185	4122	4061	4000	3939	3880	3821	3764	3707	3650
41	4313	4248	4184	4121	4060	3999	3938	3879	3820	3763	3706	3649
42	4311	4247	4183	4120	4059	3998	3937	3878	3820	3762	3705	3649
43	4310	4246	4182	4119	4058	3997	3936	3877	3819	3761	3704	3648
44	4309	4245	4181	4118	4056	3996	3935	3876	3818	3760	3703	3647
45	4308	4244	4180	4117	4055	3995	3934	3875	3817	3759	3702	3646
46	4307	4243	4179	4116	4054	3993	3933	3874	3816	3758	3701	3645
47	4306	4241	4178	4115	4053	3992	3932	3873	3815	3757	3700	3644
48	4305	4240	4177	4114	4052	3991	3931	3872	3814	3756	3699	3643
49	4304	4239	4176	4113	4051	3990	3930	3871	3813	3755	3698	3642
50	4303	4238	4175	4112	4050	3989	3929	3870	3812	3754	3697	3641
51	4302	4237	4174	4111	4049	3988	3928	3869	3811	3753	3696	3640
52	4301	4236	4173	4110	4048	3987	3927	3868	3810	3752	3695	3639
53	4300	4235	4172	4109	4047	3986	3926	3867	3809	3751	3694	3638
54	4298	4234	4171	4108	4046	3985	3925	3866	3808	3750	3693	3637
55	4297	4233	4169	4107	4045	3984	3924	3865	3807	3749	3693	3636
56	4296	4232	4168	4106	4044	3983	3923	3864	3806	3748	3692	3635
57	4295	4231	4167	4105	4043	3982	3922	3863	3805	3747	3691	3635
58	4294	4230	4166	4104	4042	3981	3921	3862	3804	3746	3690	3634
59	4293	4229	4165	4103	4041	3980	3920	3861	3803	3746	3689	3633
60	4292	4228	4164	4102	4040	3979	3919	3860	3802	3745	3688	3632
S	h m 1° 6′	h m 1° 7′	h m 1° 8′	h m 1° 9′	h m 1° 10′	h m 1° 11′	h m 1° 12′	h m 1° 13′	h m 1° 14′	h m 1° 15′	h m 1° 16′	h m 1° 17′

S	h m 1° 18'	h m 1° 19'	h m 1° 20'	h m 1° 21'	h m 1° 22'	h m 1° 23'	h m 1° 24'	h m 1° 25'	h m 1° 26'	h m 1° 27'	h m 1° 28'	h m 1° 29'
0	3632	3576	3522	3468	3415	3362	3310	3259	3208	3158	3108	3059
1	3631	3576	3521	3467	3414	3361	3309	3258	3207	3157	3107	3058
2	3630	3575	3520	3466	3413	3360	3308	3257	3206	3156	3106	3057
3	3629	3574	3519	3465	3412	3359	3307	3256	3205	3155	3105	3056
4	3628	3573	3518	3464	3411	3358	3306	3255	3204	3154	3105	3056
5	3627	3572	3517	3463	3410	3358	3306	3254	3204	3153	3104	3055
6	3626	3571	3516	3463	3409	3357	3305	3253	3203	3153	3103	3054
7	3625	3570	3515	3462	3408	3356	3304	3253	3202	3152	3102	3053
8	3624	3569	3514	3461	3408	3355	3303	3252	3201	3151	3101	3052
9	3623	3568	3514	3460	3407	3354	3302	3251	3200	3150	3101	3052
10	3623	3567	3513	3459	3406	3353	3301	3250	3199	3149	3100	3051
11	3622	3566	3512	3458	3405	3352	3300	3249	3198	3148	3099	3050
12	3621	3565	3511	3457	3404	3351	3300	3248	3198	3148	3098	3049
13	3620	3565	3510	3456	3403	3351	3299	3247	3197	3147	3097	3048
14	3619	3564	3509	3455	3402	3350	3298	3247	3196	3146	3096	3047
15	3618	3563	3508	3454	3401	3349	3297	3246	3195	3145	3096	3047
16	3617	3562	3507	3454	3400	3348	3296	3245	3194	3144	3095	3046
17	3616	3561	3506	3453	3400	3347	3295	3244	3193	3143	3094	3045
18	3615	3560	2506	3452	3399	3346	3294	3243	3193	3143	3093	3044
19	3614	3559	3505	3451	3398	3345	3293	3242	3192	3142	3092	3043
20	3613	3558	3504	3450	3397	3345	3293	3242	3191	3141	3091	3043
21	3612	3557	3503	3449	3396	3344	3292	3241	319	3140	3091	3042
22	3611	3556	3502	3448	3395	3343	3291	3240	3189	3139	3090	3041
23	3610	3555	3501	3447	3394	3342	3290	3239	3188	3138	3089	3040
24	3610	3555	3500	3446	3393	3341	3289	3238	3188	3138	3088	3039
25	3609	3554	3499	3446	3393	3340	3288	3237	3187	3137	3087	3039
26	3608	3553	3498	3445	3392	3339	3288	3236	3186	3136	3087	3038
27	3607	3552	3497	3444	3391	3338	3287	3236	3185	3135	3086	3037
28	3606	3551	3497	3443	3390	3338	3286	3235	3184	3134	3085	3036
29	3605	3550	3496	3442	3389	3337	3285	3234	3183	3133	3084	3035
30	3604	3549	3495	3441	3388	3336	3284	3233	3183	3133	3083	3034
31	3603	3548	3494	3440	3387	3335	3283	3232	3182	3132	3082	3034
32	3602	3547	3493	3439	3386	3334	3282	3231	3181	3131	3082	3033
33	3601	3546	3492	3438	3386	3333	3282	3231	3180	3130	3081	3032
34	3600	3545	3491	3438	3385	3332	3281	3230	3179	3129	3080	3031
35	3599	3545	3490	3437	3384	3332	3280	3229	3179	3129	3079	3030
36	3598	3544	3489	3436	3383	3331	3279	3228	3178	3128	3078	3030
37	3598	3543	3488	3435	3382	3330	3278	3227	3177	3127	3078	3029
38	3597	3542	3488	3434	3381	3329	3277	3226	3176	3126	3077	3028
39	3596	3541	3487	3433	3380	3328	3276	3225	3175	3125	3076	3027
40	3595	3540	3486	3432	3379	3327	3276	3225	3174	3124	3075	3026
41	3594	3539	3485	3431	3379	3326	3275	3224	3173	3124	3074	3026
42	3593	3538	3484	3431	3378	3325	3274	3223	3173	3123	3073	3025
43	3592	3537	3483	3430	3377	3325	3273	3222	3172	3122	3073	3024
44	3591	3536	3482	3429	3376	3324	3272	3221	3171	3121	3072	3023
45	3590	3535	3481	3428	3375	3323	3271	3220	3170	3120	3071	3022
46	3589	3535	3480	3427	3374	3322	3270	3220	3169	3119	3070	3022
47	3588	3534	3480	3426	3373	3321	3270	3219	3168	3119	3069	3021
48	3587	3533	3479	3425	3372	3320	3269	3218	3168	3118	3069	3020
49	3587	3532	3478	3424	3371	3319	3268	3217	3167	3117	3068	3019
50	3586	3531	3477	3423	3371	3319	3267	3216	3166	3116	3067	3018
51	3585	3530	3476	3422	3370	3318	3266	3215	3165	3115	3066	3018
52	3584	3529	3475	3422	3369	3317	3265	3214	3164	3114	3065	3017
53	3583	3528	3474	3421	3368	3316	3265	3214	3163	3114	3065	3016
54	3582	3527	3473	3420	3367	3315	3264	3213	3163	3113	3064	3015
55	3581	3526	3472	3419	3366	3314	3263	3212	3162	3112	3063	3014
56	3580	3525	3471	3418	3365	3313	3262	2211	3161	3111	3062	3014
57	3579	352	3471	3417	3365	3312	3261	3210	3160	3110	3061	3013
58	3578	3524	3470	3416	3364	3312	3260	3209	3159	3110	3060	3012
59	3577	3523	3469	3415	3363	3311	3259	3208	3158	3109	3060	3011
60	3576	3522	3468	3415	3362	3310	3259	320	3158	3108	3059	3010
S	h m 1° 18'	h m 1° 19'	h m 1° 20'	h m 1° 21'	h m 1° 22'	h m 1° 23'	h m 1° 24'	h m 1° 25'	h m 1° 26'	h m 1° 27'	h m 1° 28'	h m 1° 29'

Table XXV. Proportional Logarithms.

S	h m 1° 30′	h m 1° 31′	h m 1° 32′	h m 1° 33′	h m 1° 34′	h m 1° 35′	h m 1° 36′	h m 1° 37′	h m 1° 38′	h m 1° 39′	h m 1° 40′	h m 1° 41′
0	3010	2962	2915	2868	2821	2775	2730	2685	2640	2596	2553	2510
1	3009	2962	2914	2867	2821	2775	2729	2684	2640	2596	2552	2509
2	3009	2961	2913	2866	2820	2774	2729	2683	2639	2595	2551	2508
3	3008	2960	2912	2866	2819	2773	2728	2683	2637	2594	2551	2507
4	3007	2959	2912	2865	2818	2772	2727	2682	2638	2593	2550	2507
5	3006	2958	2911	2864	2818	2772	2726	2681	2637	2593	2549	2506
6	3005	2958	2910	2863	2817	2771	2725	2681	2636	2592	2548	2505
7	3005	2957	2909	2862	2816	2770	2725	2680	2635	2591	2548	2504
8	3004	2956	2909	2862	2815	2769	2724	2679	2635	2591	2547	2504
9	3003	2955	2908	2861	2815	2769	2723	2678	2634	2590	2546	2503
10	3002	2954	2907	2860	2814	2768	2722	2678	2633	2589	2545	2502
11	3001	2954	2906	2859	2813	2767	2722	2677	2632	2588	2545	2502
12	3001	2953	2905	2859	2812	2766	2721	2676	2632	2588	2544	2501
13	3000	2952	2905	2858	2811	2766	2720	2675	2631	2587	2543	2500
14	2999	2951	2904	2857	2811	2765	2719	2675	2630	2586	2543	2499
15	2998	2950	2903	2856	2810	2764	2719	2674	2629	2585	2542	2499
16	2997	2950	2902	2855	2809	2763	2718	2673	2629	2585	2541	2498
17	2997	2949	2901	2855	2808	2763	2717	2672	2628	2584	2540	2457
18	2996	2948	2901	2854	2808	2762	2716	2672	2627	2583	2540	2497
19	2995	2947	2900	2853	2807	2761	2716	2671	2626	2583	2539	2496
20	2994	2946	2899	2852	2806	2762	2715	2670	2626	2582	2538	2495
21	2993	2946	2898	2852	2805	2760	2714	2669	2625	2581	2538	2494
22	2993	2945	2898	2851	2805	2759	2713	2669	2624	2580	2537	2494
23	2992	2944	2897	2850	2804	2758	2713	2668	2624	2580	2536	2493
24	2991	2943	2896	2849	2803	2757	2712	2667	2623	2579	2535	2492
25	2990	2942	2895	2848	2802	2756	2711	2666	2622	2578	2535	2492
26	2989	2942	2894	2848	2801	2756	2710	2666	2621	2577	2534	2491
27	2989	2941	2894	2847	2801	2755	2710	2665	2621	2577	2533	2490
28	2988	2940	2893	2846	2800	2754	2709	2664	2620	2576	2533	2489
29	2987	2939	2892	2845	2799	2753	2708	2663	2619	2575	2532	2489
30	2986	2939	2891	2845	2798	2753	2707	2663	2618	2574	2531	2488
31	2985	2938	2891	2844	2798	2752	2707	2662	2618	2574	2530	2487
32	2985	2937	2890	2843	2797	2751	2706	2661	2617	2573	2530	2487
33	2084	2936	2889	2842	2796	2750	2705	2660	2616	2572	2529	2486
34	2983	2935	2888	2842	2795	2750	2704	2660	2615	2572	2528	2485
35	2982	2935	2887	2841	2795	2749	2704	2659	2615	2571	2527	2485
36	2981	2934	2887	2840	2794	2748	2703	2658	2614	2570	2527	2484
37	2981	2933	2886	2839	2793	2747	2702	2657	2613	2569	2526	2483
38	2980	2932	2885	2838	2792	2747	2701	2657	2612	2569	2525	2482
39	2979	2931	2884	2838	2792	2746	2701	2656	2612	2568	2525	2482
40	2978	2931	2883	2837	2791	2745	2700	2655	2611	2567	2524	2481
41	2977	2930	2883	2836	2790	2744	2699	2655	2610	2566	2523	2480
42	2977	2929	2882	2835	2789	2744	2698	2654	2610	2566	2522	2480
43	2976	2928	2881	2835	2788	2743	2698	2653	2609	2565	2522	2479
44	2975	2927	2880	2834	2788	2742	2697	2652	2608	2564	2521	2478
45	2974	2927	2880	2833	2787	2741	2696	2652	2607	2564	2520	2477
46	2973	2926	2879	2832	2786	2741	2696	2651	2607	2563	2520	2477
47	2973	2925	2878	2831	2785	2740	2695	2650	2606	2562	2519	2476
48	2972	2924	2877	2831	2785	2739	2694	2649	2605	2561	2518	2475
49	2971	2924	2876	2830	2784	2738	2693	2649	2604	2561	2517	2475
50	2970	2923	2876	2829	2783	2738	2692	2648	2604	2560	2517	2474
51	2969	2922	2875	2828	2782	2737	2692	2647	2603	2559	2516	2473
52	2969	2921	2874	2828	2782	2736	2691	2646	2602	2558	2515	2472
53	2968	2920	2873	2827	2781	2735	2690	2646	2601	2558	2515	2472
54	2967	2920	2873	2826	2780	2735	2689	2645	2601	2557	2514	2471
55	2966	2919	2872	2825	2779	2734	2689	2644	2600	2556	2513	2470
56	2965	2918	2871	2825	2779	2733	2688	2643	2599	2556	2512	2470
57	2965	2917	2870	2824	2778	2732	2687	2643	2599	2555	2512	2469
58	2964	2916	2869	2823	2777	2732	2687	2642	2598	2554	2511	2468
59	2963	2916	2869	2822	2776	2731	2686	2641	2597	2553	2510	2467
60	2962	2915	2868	2821	2775	2730	2685	2640	2596	2553	2510	2467
S	h m 1° 30′	h m 1° 31′	h m 1° 32′	h m 1° 33′	h m 1° 34′	h m 1° 35′	h m 1° 36′	h m 1° 37′	h m 1° 38′	h m 1° 39′	h m 1° 40′	h m 1° 41′

S.	h m 1° 42′	h m 1° 43′	h m 1° 44′	h m 1° 45′	h m 1° 46′	h m 1° 47′	h m 1° 48′	h m 1° 49′	h m 1° 50′	h m 1° 51′	h m 1° 52′	h m 1° 53′
0	2467	2424	2382	2341	2300	2259	2218	2178	2139	2099	2061	2022
1	2466	2424	2382	2340	2299	2258	2218	2178	2138	2099	2060	2021
2	2465	2423	2381	2339	2298	2258	2217	2177	2137	2098	2059	2021
3	2465	2422	2380	2339	2298	2257	2216	2176	2137	2098	2059	2020
4	2464	2422	2380	2338	2297	2256	2216	2176	2136	2097	2058	2019
5	2463	2421	2379	2337	2296	2256	2215	2175	2136	2096	2057	2019
6	2462	2420	2378	2337	2296	2255	2214	2174	2135	2090	2057	2018
7	2462	2419	2378	2336	2295	2254	2214	2174	2134	2095	2056	2017
8	2461	2419	2377	2335	2294	2253	2213	2173	2134	2094	2055	2017
9	2460	2418	2376	2335	2204	2253	2212	2172	2133	2094	2055	2016
10	2460	2417	2375	2334	2293	2252	2212	2172	2132	2093	2054	2016
11	2459	2417	2375	2333	2292	2251	2211	2171	2132	2092	2053	2015
12	2458	2416	2374	2333	2291	2251	2210	2170	2131	2092	2053	2014
13	2458	2415	2373	2332	2291	2250	2210	2170	2130	2091	2052	2014
14	2457	2415	2373	2331	2290	2249	2209	2169	2130	2090	2052	2013
15	2456	2414	2372	2331	2289	2249	2208	2169	2129	2090	2051	2012
16	2455	2413	2371	2330	2289	2248	2208	2168	2128	2089	2050	2012
17	2455	2412	2371	2329	2288	2247	2207	2167	2128	2088	2050	2011
18	2454	2412	2370	2328	2287	2247	2206	2167	2127	2088	2049	2010
19	2453	2411	2369	2328	2287	2246	2206	2166	2126	2087	2048	2010
20	2453	2410	2368	2327	2286	2245	2205	2165	2126	2086	2048	2009
21	2452	2410	2368	2326	2285	2245	2204	2165	2125	2086	2047	2009
22	2451	2409	2367	2326	2285	2244	2204	2164	2124	2085	2046	2008
23	2450	2408	2366	2325	2284	2243	2203	2163	2124	2085	2046	2007
24	2450	2408	2366	2324	2283	2243	2202	2163	2123	2084	2045	2007
25	2449	2407	2365	2324	2283	2242	2202	2162	2122	2083	2044	2006
26	2448	2406	2364	2323	2282	2241	2201	2161	2122	2083	2044	2005
27	2448	2405	2364	2322	2281	2241	2200	2161	2121	2082	2043	2005
28	2447	2405	2363	2322	2281	2240	2200	2160	2120	2081	2042	2004
29	2446	2404	2362	2321	2280	2239	2199	2159	2120	2081	2042	2003
30	2445	2403	2362	2320	2279	2239	2198	2159	2119	2080	2041	2003
31	2445	2403	2361	2320	2279	2238	2198	2158	2118	2079	2041	2002
32	2444	2402	2360	2319	2278	2237	2197	2157	2118	2079	2040	2001
33	2443	2401	2359	2318	2277	2237	2196	2157	2117	2078	2039	2001
34	2443	2401	2359	2317	2277	2236	2196	2156	2116	2077	2039	2000
35	2442	2400	2358	2317	2276	2235	2195	2155	2116	2077	2038	2000
36	2441	2399	2357	2316	2275	2235	2194	2155	2115	2076	2037	1999
37	2441	2398	2357	2315	2274	2234	2194	2154	2115	2075	2037	1998
38	2440	2398	2356	2315	2274	2233	2193	2153	2114	2075	2036	1998
39	2439	2397	2355	2314	2273	2233	2192	2153	2113	2074	2035	1997
40	2438	2396	2355	2313	2272	2232	2192	2152	2113	2073	2035	1996
41	2438	2396	2354	2313	2272	2231	2191	2151	2112	2073	2034	1996
42	2437	2395	2353	2312	2271	2231	2190	2151	2111	2072	2033	1995
43	2436	2394	2353	2311	2270	2230	2190	2150	2111	2072	2033	1994
44	2436	2394	2352	2311	2270	2229	2189	2149	2110	2071	2032	1994
45	2435	2393	2351	2310	2269	2229	2188	2149	2109	2070	2032	1993
46	2434	2392	2350	2309	2268	2228	2188	2148	2109	2070	2031	1993
47	2433	2391	2350	2309	2268	2227	2187	2147	2108	2069	2030	1992
48	2433	2391	2349	2308	2267	2227	2186	2147	2107	2068	2030	1991
49	2432	2390	2348	2307	2266	2226	2186	2146	2107	2068	2029	1991
50	2431	2389	2348	2307	2266	2225	2185	2145	2106	2067	2028	1990
51	2431	2389	2347	2306	2265	2225	2184	2145	2105	2066	2028	1989
52	2430	2388	2346	2305	2264	2224	2184	2144	2105	2066	2027	1989
53	2429	2387	2346	2304	2264	2223	2183	2143	2104	2065	2026	1988
54	2429	2387	2345	2304	2263	2223	2182	2143	2103	2064	2026	1987
55	2428	2386	2344	2303	2262	2222	2182	2142	2103	2064	2025	1987
56	2427	2385	2344	2302	2262	2221	2181	2141	2102	2063	2025	1986
57	2426	2384	2343	2302	2261	2220	2180	2141	2101	2062	2024	1986
58	2426	2384	2342	2301	2260	2220	2180	2140	2101	2062	2023	1985
59	2425	2383	2342	2300	2260	2219	2179	2139	2100	2061	2023	1984
60	2424	2382	234	2300	2259	2218	2178	2139	2099	2061	2022	1984
S.	h m 1° 42′	h m 1° 43′	h m 1° 44′	h m 1° 45′	h m 1° 46′	h m 1° 47′	h m 1° 48′	h m 1° 49′	h m 1° 50′	h m 1° 51′	h m 1° 52′	h m 1° 53′

S	h m 1° 54′	h m 1° 55′	h m 1° 56′	h m 1° 57′	h m 1° 58′	h m 1° 59′	h m 2° 0′	h m 2° 1′	h m 2° 2′	h m 2° 3′	h m 2° 4′
0	1984	1946	1908	1871	1834	1797	1761	1725	1689	1654	1619
1	1983	1945	1908	1870	1833	1797	1760	1724	1689	1653	1618
2	1982	1944	1907	1870	1833	1796	1760	1724	1688	1652	1617
3	1982	1944	1906	1869	1832	1795	1759	1723	1687	1652	1617
4	1981	194	1906	1868	1831	1795	1759	1722	1687	1651	1616
5	1981	1943	1905	1868	1831	1794	1758	1722	1686	1651	1616
6	1980	1942	1904	1867	1830	1794	1757	1721	1686	1650	1615
7	1979	1941	1904	1867	1830	1793	1757	1721	1685	1650	1615
8	1979	1941	1903	1866	1829	1792	1756	1720	1684	1649	1614
9	1978	1940	1903	1865	1828	1792	1755	1719	1684	1648	1613
10	1977	1939	1902	1865	1828	1791	1755	1719	1683	1648	1613
11	1977	1939	1901	1864	1827	1791	1754	1718	1683	1647	1612
12	1976	1938	1901	1863	1827	1790	1754	1718	1682	1647	1612
13	1975	1938	1900	1863	1826	1789	1753	1717	1681	1646	1611
14	1975	1937	1899	1862	1825	1789	1752	1717	1681	1645	1610
15	1974	1936	1899	1862	1825	1788	1752	1716	1680	1645	1610
16	1974	1936	1898	1861	1824	1788	1751	1715	1680	1644	1609
17	1973	1935	1898	1860	1823	1787	1751	1715	1679	1644	1609
18	1972	1934	1897	1860	1823	1786	1750	1714	1678	1643	1608
19	1972	1934	1896	1859	1822	1786	1749	1714	1678	1643	1607
20	1971	1933	1896	1859	1822	1785	1749	1713	1677	1642	1607
21	1970	1933	1895	1858	1821	1785	1748	1712	1677	1641	1606
22	1970	1932	1894	1857	1820	1784	1748	1712	1676	1641	1606
23	1969	1931	1894	1857	1820	1783	1747	1711	1676	1640	1605
24	1968	1931	1893	1856	1819	1783	1746	1711	1675	1640	1605
25	1968	1930	1893	1855	1819	1782	1746	1710	1674	1639	1604
26	1967	1929	1892	1855	1818	1781	1745	1709	1674	1638	1603
27	1967	1929	1891	1854	1817	1781	1745	1709	1673	1638	1603
28	1966	1928	1891	1854	1817	1780	1744	1708	1673	1637	1602
29	1965	1928	1890	1853	1816	1780	1743	1708	1672	1637	1602
30	1965	1927	1889	1852	1816	1779	1743	1707	1671	1636	1601
31	1964	1926	1889	1852	1815	1778	1742	1706	1671	1635	1600
32	1963	1926	1888	1851	1814	1778	1742	1706	1670	1635	1600
33	1963	1925	1888	1850	1814	1777	1741	1705	1670	1634	1599
34	1962	1924	1887	1850	1813	1777	1740	1705	1669	1634	1599
35	1962	1924	1886	1849	1812	1776	1740	1704	1668	1633	1598
36	1961	1923	1886	1849	1812	1775	1739	1703	1668	1633	1598
37	1960	1923	1885	1848	1811	1775	1739	1703	1667	1632	1597
38	1960	1922	1884	1847	1811	1774	1738	1702	1667	1631	1596
39	1959	1921	1884	1847	1810	1774	1737	1702	1666	1631	1596
40	1958	1921	1883	1846	1809	1773	1737	1701	1665	1630	1595
41	1958	1920	1883	1846	1809	1772	1736	1700	1665	1630	1595
42	1957	1919	1882	1845	1808	1772	1736	1700	1664	1629	1594
43	1956	1919	1881	1844	1808	1771	1735	1699	1664	1628	1593
44	1956	1918	1881	1844	1807	1771	1734	1699	1663	1628	1593
45	1955	1918	1880	1843	1806	1770	1734	1698	1663	1627	1592
46	1955	1917	1880	1843	1806	1769	1733	1697	1662	1627	1592
47	1954	1916	1879	1842	1805	1769	1733	1697	1661	1626	1591
48	1953	1916	1878	1841	1805	1768	1732	1696	1661	1626	1591
49	1953	1915	1878	1841	1804	1768	1731	1696	1660	1625	1590
50	1952	1914	1877	1840	1803	1767	1731	1695	1660	1624	1589
51	1951	1914	1876	1839	1803	1766	1730	1694	1659	1624	1589
52	1951	1913	1876	1839	1802	1766	1730	1694	1658	1623	1588
53	1950	1913	1875	1838	1802	1765	1729	1693	1658	1623	1588
54	1950	1912	1875	1838	1801	1765	1728	1693	1657	1622	1587
55	1949	1911	1874	1837	1800	1764	1728	1692	1657	1621	1587
56	1948	1911	1873	1836	1800	1763	1727	1692	1656	1621	1586
57	1948	1910	1873	1836	1799	1763	1727	1691	1655	1620	1585
58	1947	1909	1872	1835	1798	1762	1726	1690	1655	1620	1585
59	1946	1909	1871	1835	1798	1762	1725	1690	1654	1619	1584
60	1946	1908	1871	1834	1797	1761	1725	1689	1654	1619	1584
S	h m 1° 54′	h m 1° 55′	h m 1° 56′	h m 1° 57′	h m 1° 58′	h m 1° 59′	h m 2° 0′	h m 2° 1′	h m 2° 2′	h m 2° 3′	h m 2° 4′

Table XXV. Proportional Logarithms.

S.	h m 2° 5′	h m 2° 6′	h m 2° 7′	h m 2° 8′	h m 2° 9′	h m 2° 10′	h m 2° 11′	h m 2° 12′	h m 2° 13′	h m 2° 14′	h m 2° 15′
0	1584	1549	1515	1481	1447	1413	1380	1347	1314	1282	1249
1	1583	1548	1514	1480	1446	1413	1379	1346	1314	1281	1249
2	1582	1548	1514	1479	1446	1412	1379	1346	1313	1281	1248
3	1582	1547	1513	1479	1445	1412	1378	1345	1313	1280	1248
4	1581	1547	1512	1478	1445	1411	1378	1345	1312	1280	1247
5	1581	1546	1512	1478	1444	1411	1377	1344	1312	1279	1247
6	1580	1546	1511	1477	1443	1410	1377	1344	1311	1278	1246
7	1580	1575	1511	1477	1443	1409	1376	1343	1310	1278	1246
8	1579	1544	1510	1476	1442	1409	1376	1343	1310	1277	1245
9	1578	1544	1510	1476	1442	1408	1375	1342	1309	1277	1245
10	1578	1543	1509	1475	1441	1408	1374	1342	1309	1276	1244
11	1577	1543	1508	1474	1441	1407	1374	1341	1308	1276	1243
12	1577	1542	1508	1474	1440	1407	1373	1340	1308	1275	1243
13	1576	1542	1507	1473	1440	1406	1373	1340	1307	1275	1242
14	1576	1541	1507	1473	1439	1406	1372	1339	1307	1274	1242
15	1575	1540	1506	1472	1438	1405	1372	1339	1306	1274	1241
16	1574	1540	1506	1472	1438	1404	1371	1338	1306	1273	1241
17	1574	1539	1505	1471	1437	1404	1371	1338	1305	1273	1240
18	1573	1539	1504	1470	1437	1403	1570	1337	1304	1272	1240
19	1573	1538	1504	1470	1436	1403	1370	1337	1304	1271	1239
20	1572	1538	1503	1469	1436	1402	1369	1336	1303	1271	1239
21	1571	1537	1503	1469	1435	1402	1368	1335	1303	1270	1238
22	1571	1536	1502	1468	1435	1401	1368	1335	1302	1270	1238
23	1570	1536	1502	1468	1434	1401	1367	1334	1302	1269	1237
24	1570	1535	1301	1467	1433	1400	1367	1334	1301	1269	1237
25	1569	1535	1500	1467	1433	1399	1366	1333	1301	1268	1236
26	1568	1534	1500	1466	1432	1399	1366	1333	1300	1268	1235
27	1568	1534	1499	1465	1432	1398	1365	1332	1300	1267	1235
28	1567	1533	1499	1465	1431	1398	1365	1332	1299	1267	1234
29	1567	1532	1498	1464	1439	1397	1364	1331	1298	1266	1234
30	1566	1532	1498	1464	1430	1397	1363	1331	1298	1266	1233
31	1566	1531	1497	1463	1429	1396	1363	1330	1297	1265	1233
32	1565	1531	1496	1463	1429	1396	1362	1329	1297	1264	1232
33	1565	1530	1496	1462	1428	1395	1362	1329	1296	1264	1232
34	1564	1530	1495	1461	1428	1394	1361	1328	1296	1263	1231
35	1563	1529	1495	1461	1427	1394	1361	1328	1295	1263	1231
36	1563	1528	1494	1460	1427	1393	1360	1327	1295	1262	1230
37	1562	1528	1494	1460	1426	1393	1360	1327	1294	1262	1230
38	1562	1527	1493	1459	1426	1392	1359	1326	1294	1261	1229
39	1561	1527	1493	1459	1425	1392	1359	1326	1293	1261	1229
40	1561	1526	1492	1458	1424	1391	1358	1325	1292	1260	1228
41	1560	1526	1491	1458	1424	1391	1357	1325	1292	1260	1227
42	1559	1525	1491	1457	1423	1390	1357	1324	1291	1259	1227
43	1559	1524	1490	1456	1423	1389	1356	1323	1291	1259	1226
44	1558	1524	1490	1456	1422	1389	1356	1323	1290	1258	1226
45	1558	1523	1489	1455	1422	1388	1355	1322	1290	1257	1225
46	1557	1523	1489	1455	1421	1388	1355	1322	1289	1257	1225
47	1556	1522	1488	1454	1421	1387	1354	1321	1289	1256	1224
48	1556	1522	1487	1454	1420	1387	1354	1321	1288	1256	1224
49	1555	1521	1487	1453	1419	1386	1353	1320	1288	1255	1223
50	1555	1520	1486	1452	1419	1386	1352	1320	1287	1255	1223
51	1554	1520	1486	1452	1418	1385	1352	1319	1287	1254	1222
52	1554	1519	1485	1451	1418	1384	1351	1319	1286	1254	1222
53	1553	1519	1485	1451	1417	1384	1351	1318	1285	1253	1221
54	1552	1518	1484	1450	1417	1383	1350	1317	1285	1253	1221
55	1552	1518	1483	1450	1416	1383	1350	1317	1284	1252	1220
56	1551	1517	1483	1449	1416	1382	1349	1316	1284	1252	1219
57	1551	1516	1482	1449	1415	1382	1349	1316	1283	1251	1219
58	1550	1516	1482	1448	1414	1381	1348	1315	1283	1250	1218
59	1550	1515	1481	1447	1414	1381	1348	1315	1282	1250	1218
60	1549	1515	1481	1447	1413	1380	1347	1314	1282	1249	1217
S.	h m 2° 5′	h m 2° 6′	h m 2° 7′	h m 2° 8′	h m 2° 9′	h m 2° 10′	h m 2° 11′	h m 2° 12′	h m 2° 13′	h m 2° 14′	h m 2° 15′

S.	h m 2° 16′	h m 2° 17′	h m 2° 18′	h m 2° 19′	h m 2° 20′	h m 2° 21′	h m 2° 22′	h m 2° 23′	h m 2° 24′	h m 2° 25′	h m 2° 26′
0	1217	1186	1154	1123	1091	1061	1030	0999	0969	0939	0909
1	1217	1185	1153	1122	1091	1060	1029	999	969	939	909
2	1216	1184	1153	1122	1090	1060	1029	998	968	938	908
3	1216	1184	1152	1121	1090	1059	1028	998	968	938	908
4	1215	1183	1152	1120	[illegible]	1058	1028	997	967	937	907
5	1215	1183	1151	1120	1089	1058	1027	997	967	937	907
6	1214	1182	1151	1119	1088	1057	1027	996	966	936	906
7	1214	1182	1150	1119	1088	1057	1026	996	966	936	906
8	1213	1181	1150	1118	1087	1056	1026	995	965	935	905
9	1213	1181	1149	1118	1087	1056	1025	995	965	935	905
10	1212	1180	1149	1117	1086	1055	1025	0994	0964	0934	0904
11	1211	1180	1148	1117	1086	1055	1024	994	964	934	904
12	1211	1179	1148	1116	1085	1054	1024	993	963	933	903
13	1210	1179	1147	1116	1085	1054	1023	993	963	933	903
14	1210	1178	1147	1115	1084	1053	1023	992	962	932	902
15	1209	1178	1146	1115	1084	1053	1022	992	962	932	902
16	1209	1177	1146	1114	1083	1052	1022	991	961	931	901
17	1208	1177	1145	1114	1083	1052	1021	991	961	931	901
18	1208	1176	1145	1113	1082	1051	1021	990	960	930	900
19	1207	1175	1144	1113	1082	1051	1020	990	960	930	900
20	1207	1175	1143	1112	1081	1050	1020	0989	0959	0929	0899
21	1206	1174	1143	1112	1081	1050	1019	989	959	929	899
22	1206	1174	1142	1111	1080	1049	1019	988	958	928	898
23	1205	1173	1142	1111	1080	1049	1018	988	958	928	898
24	1205	1173	1141	1110	1079	1048	1018	987	957	927	897
25	1204	1172	1141	1110	1079	1048	1017	987	957	927	897
26	1204	1172	1140	1109	1078	1047	1017	986	956	926	896
27	1203	1171	1140	1109	1078	1047	1016	986	956	926	896
28	1202	1171	1139	1108	1077	1046	1016	985	955	925	895
29	1202	1170	1139	1108	1076	1046	1015	985	955	925	895
30	1201	1170	1138	1107	1076	1045	1015	0984	0954	0924	0894
31	1201	1169	1138	1106	1075	1045	1014	984	954	924	894
32	1200	1169	1137	1106	1075	1044	1014	983	953	923	893
33	1200	1168	1137	1105	1074	1044	1013	983	953	923	893
34	1199	1168	1136	1105	1074	1043	1013	982	952	922	892
35	1199	1167	1136	1104	1073	1043	1012	982	952	922	892
36	1198	1167	1135	1104	1073	1042	1012	981	951	921	891
37	1198	1166	1135	1103	1072	1042	1011	981	951	921	891
38	1197	1165	1134	1103	1072	1041	1011	980	950	920	890
39	1197	1165	1134	1102	1071	1041	1010	980	950	920	890
40	1196	1164	1133	1102	1071	1040	1009	0979	0949	0919	0889
41	1196	1164	1132	1101	1070	1040	1009	979	949	919	889
42	1195	1163	1132	1101	1070	1039	1008	978	948	918	888
43	1195	1163	1131	1100	1069	1039	1008	978	948	918	888
44	1194	1162	1131	1100	1069	1038	1007	977	947	917	887
45	1193	1162	1130	1099	1068	1037	1007	977	947	917	887
46	1193	1161	1130	1099	1068	1037	1006	976	946	916	886
47	1192	1161	1129	1098	1067	1036	1006	976	946	916	886
48	1192	1160	1129	1098	1067	1036	1005	975	945	915	885
49	1191	1160	1128	1097	1066	1035	1005	975	945	915	885
50	1191	1159	1128	1097	1066	1035	1004	0974	0944	0914	0884
51	1190	1159	1127	1096	1065	1034	1004	974	944	914	884
52	1190	1158	1127	1096	1065	1034	1003	973	943	913	883
53	1189	1158	1126	1095	1064	1033	1003	973	943	913	883
54	1189	1157	1126	1095	1064	1033	1002	972	942	912	883
55	1188	1157	1125	1094	1063	1032	1002	972	942	912	882
56	1188	1156	1125	1094	1063	1032	1001	971	941	911	882
57	1187	1156	1124	1093	1062	1031	1001	971	941	911	881
58	1187	1155	1124	1092	1062	1031	1000	970	940	910	881
59	1186	1154	1123	1092	1061	1030	1000	970	940	919	880
60	1186	1154	1123	1091	1061	1030	0999	0969	0939	0909	0880
S.	h m 2° 16′	h m 2° 17′	h m 2° 18′	h m 2° 19′	h m 2° 20′	h m 2° 21′	h m 2° 22′	h m 2° 23′	h m 2° 24′	h m 2° 25′	h m 2° 26′

Table XXV. Proportional Logarithms.

S.	h m 2° 27′	h m 2° 28′	h m 2° 29′	h m 2° 30′	h m 2° 31′	h m 2° 32′	h m 2° 33′	h m 2° 34′	h m 2° 35′	h m 2° 36′	h m 2° 37′
0	0880	0850	0821	0792	0763	0734	0706	0678	0649	0621	0594
1	879	850	820	791	762	734	705	677	649	621	593
2	879	849	820	791	762	733	705	677	648	621	593
3	878	849	819	790	762	733	704	676	648	620	592
4	878	848	819	790	761	732	704	676	648	620	592
5	877	848	818	789	761	732	703	675	647	619	591
6	877	847	818	789	760	731	703	675	647	619	591
7	876	847	817	788	760	731	703	674	646	618	591
8	876	846	817	788	759	730	702	674	646	618	590
9	875	846	816	787	759	730	702	673	645	617	590
10	0875	0845	0816	0787	0758	0730	0701	0673	0645	0617	0589
11	874	845	816	787	758	729	701	672	644	616	589
12	874	844	815	786	757	729	700	672	644	616	588
13	873	844	815	786	757	728	700	671	643	615	588
14	873	843	814	785	756	728	699	671	643	615	587
15	872	843	814	785	756	727	699	670	642	615	587
16	872	842	813	784	755	727	698	670	642	614	586
17	871	842	813	784	755	726	698	670	641	614	586
18	871	841	812	783	754	726	697	669	641	613	585
19	870	841	812	783	754	725	697	669	641	613	585
20	0870	0840	0811	0782	0753	0725	0696	0668	0640	0612	0585
21	869	840	811	782	753	724	696	668	640	612	584
22	869	839	810	781	752	724	695	667	639	611	584
23	868	839	810	781	752	723	695	667	639	611	583
24	868	838	809	780	751	723	695	666	638	610	583
25	867	838	809	780	751	722	694	666	638	610	582
26	867	837	808	779	751	722	694	665	637	609	582
27	866	837	808	779	750	721	693	665	637	609	581
28	866	836	807	778	750	721	693	664	636	609	581
29	865	836	807	778	749	721	692	664	636	608	580
30	0865	0835	0806	0777	0749	0720	0692	0663	0635	0608	0580
31	864	835	806	777	748	720	691	663	635	607	579
32	864	834	805	776	748	719	691	663	635	607	579
33	863	834	805	776	747	719	690	662	634	606	579
34	863	834	804	775	747	718	690	662	634	606	578
35	862	833	804	775	746	718	689	661	633	605	578
36	862	833	803	774	746	717	689	661	633	605	577
37	861	832	803	774	745	717	688	660	632	604	577
38	861	832	802	774	745	716	688	660	632	604	576
39	860	831	802	773	744	716	687	659	631	603	576
40	0860	0831	0801	0773	0744	0715	0687	0659	0631	0603	0575
41	859	830	801	772	743	715	686	658	630	602	575
42	859	830	801	772	743	714	686	658	630	602	574
43	858	829	800	771	742	714	686	657	629	602	574
44	858	829	800	771	742	713	685	657	629	601	573
45	857	828	799	770	741	713	685	656	628	601	573
46	857	828	799	770	741	712	684	656	628	600	573
47	856	827	798	769	740	712	684	655	628	600	572
48	856	827	798	769	740	711	683	655	627	599	572
49	855	826	797	768	740	711	683	655	627	599	571
50	0855	0826	0797	0768	0739	0711	0682	0654	0626	0598	0571
51	855	825	796	767	739	710	682	654	626	598	570
52	854	825	796	767	738	710	681	653	625	597	570
53	854	824	795	766	738	709	681	653	625	597	569
54	853	824	795	766	737	709	680	652	624	596	569
55	853	823	794	765	737	708	680	652	624	596	568
56	852	823	794	765	736	708	679	651	623	596	568
57	852	822	793	764	736	707	679	651	623	595	568
58	851	822	793	764	735	707	678	650	622	595	567
59	851	821	792	763	735	706	678	650	622	594	567
60	0850	0821	0792	0763	0734	0706	0678	0649	0621	0594	0566
S.	h m 2° 27′	h m 2° 28′	h m 2° 29′	h m 2° 30′	h m 2° 31′	h m 2° 32′	h m 2° 33′	h m 2° 34′	h m 2° 35′	h m 2° 36′	h m 2° 37′

S.	h m 2° 38′	h m 2° 39′	h m 2° 40′	h m 2° 41′	h m 2° 42′	h m 2° 43′	h m 2° 44′	h m 2° 45′	h m 2° 46′	h m 2° 47′	h m 2° 48′
0	0566	0539	0512	0484	0458	0431	0404	0378	0352	0326	0300
1	566	538	511	484	457	430	404	377	351	325	299
2	565	538	511	484	457	430	403	377	351	325	299
3	565	537	510	483	456	430	403	377	350	324	298
4	564	537	510	483	456	429	403	376	350	324	298
5	564	536	509	482	455	429	402	376	349	323	297
6	563	536	509	482	455	428	402	375	349	323	297
7	563	536	508	481	454	428	401	375	349	323	297
8	562	535	508	481	454	427	401	374	348	322	296
9	562	535	507	480	454	427	400	374	348	322	296
10	0562	0534	0507	0480	0453	0426	0400	0374	0347	0321	0295
11	561	534	507	480	453	426	399	373	347	321	295
12	561	533	506	479	452	426	399	373	346	320	294
13	560	533	506	479	452	425	399	372	346	320	294
14	560	532	505	478	451	425	398	372	346	319	294
15	559	532	505	478	451	424	398	371	345	319	293
16	559	531	504	477	450	424	397	371	345	319	293
17	558	531	504	477	450	423	397	370	344	318	292
18	558	531	503	476	450	423	396	370	344	318	292
19	557	530	503	476	449	422	396	370	343	317	291
20	0557	0530	0502	0475	0449	0422	0395	0369	0343	0317	0291
21	557	529	502	475	448	422	395	369	342	316	291
22	556	529	502	475	448	421	395	368	342	316	290
23	556	528	501	474	447	421	394	368	342	316	290
24	555	528	501	474	447	420	394	367	341	315	289
25	555	527	500	473	446	420	393	367	341	315	289
26	554	527	500	473	446	419	393	366	340	314	288
27	554	526	499	472	446	419	392	366	340	314	288
28	553	526	499	472	445	418	392	366	339	313	288
29	553	526	498	471	445	418	391	365	339	313	287
30	0552	0525	0498	0471	0444	0418	0391	0365	0339	0313	0287
31	552	525	498	471	444	417	391	364	338	312	286
32	552	524	497	470	443	417	390	364	338	312	286
33	551	524	497	470	443	416	390	363	337	311	285
34	551	523	496	469	442	416	389	363	337	311	285
35	550	523	496	469	442	415	389	363	336	310	285
36	550	522	495	468	442	415	388	362	336	310	284
37	549	522	495	468	441	414	388	362	336	310	284
38	549	521	494	467	441	414	388	361	335	309	283
39	548	521	494	467	440	414	387	361	335	309	283
40	0548	0521	0493	0467	0440	0413	0387	0360	0334	0308	0282
41	547	520	493	466	439	413	386	360	334	308	282
42	547	520	493	466	439	412	386	360	333	307	282
43	546	519	492	465	438	412	385	359	333	307	281
44	546	519	492	465	438	411	385	359	333	307	281
45	546	518	491	464	438	411	384	358	332	306	280
46	545	518	491	464	437	410	384	358	332	306	280
47	545	517	490	463	437	410	384	357	331	305	279
48	544	517	490	463	436	410	383	357	331	305	279
49	544	517	489	462	436	409	383	356	330	304	279
50	0543	0516	0489	0462	0435	0409	0382	0356	0330	0304	0278
51	543	516	489	462	435	408	382	356	329	304	278
52	542	515	488	461	434	408	381	355	329	303	277
53	542	515	488	461	434	407	381	355	329	303	277
54	541	514	487	460	434	407	381	354	328	302	276
55	541	514	487	460	433	406	380	354	328	302	276
56	541	513	486	459	433	406	380	353	327	301	276
57	540	513	486	459	432	406	370	353	327	301	275
58	540	512	485	458	432	405	379	353	326	300	275
59	539	512	485	458	431	405	378	352	326	300	274
6	0539	0512	0484	0458	0431	0404	0378	0352	0326	0300	0274
S.	h m 2° 38′	h m 2° 39′	h m 2° 40′	h m 2° 41′	h m 2° 42′	h m 2° 43′	h m 2° 44′	h m 2° 45′	h m 2° 46′	h m 2° 47′	h m 2° 48′

TABLE XXV. PROPORTIONAL LOGARITHMS.

S	h m 2° 49′	h m 2° 50′	h m 2° 51′	h m 2° 52′	h m 2° 53	h m 2° 54′	h m 2° 55′	h m 2° 56′	h m 2° 57′	h m 2° 58′	h m 2° 59′
0	0274	0248	0223	0197	0172	0147	0122	0098	0073	0049	0024
1	273	248	222	197	172	147	122	97	73	48	24
2	273	247	222	197	171	146	122	97	72	48	23
3	273	247	221	196	171	146	121	96	72	47	23
4	272	247	221	196	171	146	121	96	71	47	23
5	272	246	221	195	170	145	120	96	71	46	22
6	271	246	220	195	170	145	120	95	71	46	22
7	271	245	220	194	169	144	119	95	70	46	21
8	270	245	219	194	169	144	119	94	70	45	21
9	270	244	219	194	169	143	119	94	69	45	21
10	0270	0244	0219	0193	0168	0143	0118	0093	0069	0044	0020
11	269	244	218	193	168	143	118	93	68	44	20
12	269	243	218	192	167	142	117	93	68	44	19
13	268	243	217	192	167	142	117	92	68	43	19
14	268	242	217	192	166	141	117	92	67	43	19
15	267	242	216	191	166	141	116	91	67	42	18
16	267	241	216	191	166	141	116	91	66	42	18
17	267	241	216	190	165	140	115	91	66	42	17
18	266	241	215	190	165	140	115	90	66	41	17
19	266	240	215	189	164	139	114	90	65	41	17
20	0265	0240	0214	0189	0164	0139	0114	0089	0065	0040	0016
21	265	239	214	189	163	139	114	89	64	40	16
22	264	239	213	188	163	138	113	89	64	40	15
23	264	238	213	188	163	138	113	88	64	39	15
24	264	238	213	187	162	137	112	88	63	39	15
25	263	238	212	187	162	137	112	87	63	38	14
26	263	237	212	187	161	136	112	87	62	38	14
27	262	237	211	186	161	136	111	87	62	38	13
28	262	236	211	186	161	136	111	86	62	37	13
29	261	236	211	185	160	135	110	86	61	37	12
30	0261	0235	0210	0185	0160	0135	0110	0085	0061	0036	0012
31	261	235	210	184	159	134	110	85	60	36	12
32	260	235	209	184	159	134	109	84	60	36	11
33	260	234	209	184	158	134	109	84	60	35	11
34	259	234	208	183	158	133	108	84	59	35	10
35	259	233	208	183	158	133	108	83	59	34	10
36	258	233	208	182	157	132	107	83	58	34	10
37	258	233	207	182	157	132	107	82	58	34	9
38	258	232	207	181	156	131	107	82	57	33	9
39	257	232	206	181	156	131	106	82	57	33	8
40	0257	0231	0206	0181	0156	0131	0106	0081	0057	0032	0008
41	256	231	205	180	155	130	105	81	56	32	8
42	256	230	205	180	155	130	105	80	56	31	7
43	255	230	205	179	154	129	105	80	55	31	7
44	255	230	204	179	154	129	104	80	55	31	6
45	255	229	204	179	153	129	104	79	55	30	6
46	254	229	203	178	153	128	103	79	54	30	6
47	254	228	203	178	153	128	103	78	54	29	5
48	253	228	202	177	152	127	102	78	53	29	5
49	253	227	202	177	152	127	102	77	53	29	4
50	0252	0227	0202	0176	0151	0126	0102	0077	0053	0028	0004
51	252	227	201	176	151	126	[illegible]	77	52	28	4
52	252	226	201	176	151	126	[illegible]	76	52	27	3
53	251	226	200	175	150	125	[illegible]	76	51	27	3
54	251	225	200	175	150	125	100	75	51	[illegible]	2
55	250	225	200	174	149	124	100	75	51	[illegible]	2
56	250	224	199	174	149	124	[illegible]	75	50	26	2
57	250	224	198	174	148	124	099	74	50	[illegible]	1
58	249	224	[illegible]	173	148	123	098	74	49	[illegible]	1
59	249	223	[illegible]	172	148	123	098	73	49	[illegible]	0
60	0248	0223	0197	0172	0147	0122	0098	0073	0049	[illegible]	0000
S	h m 2° 49′	h m 2° 50′	h m 2° 51′	h m 2° 52′	h m 2° 53′	h m 2° 54′	h m 2° 55′	h m 2° 56′	h m 2° 57′	h m 2° 58′	h m 2° 59′

TABLE XXVI. For computing the Effects of Parallax on the Moon's Distance from the Sun or a Star.

Parallax in Alt. or Dist.	Apparent Distance. Add the Difference of the two Numbers out of this Table, if the Apparent Distance is less than 90°, and subtract it if above																				
	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°	21°	22°	23°	24°	25°	26°	27°	28°	29°	30°
M.	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
5	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
8	3	3	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1
10	5	5	4	4	4	3	3	3	3	2	2	2	2	2	2	2	2	2	2	1	1
11	6	5	5	4	4	4	4	3	3	3	3	3	3	3	2	2	2	2	2	2	2
12	7	6	6	5	5	4	4	4	4	3	3	3	3	3	3	3	3	2	2	2	2
13	8	8	7	6	6	5	5	5	5	4	4	4	3	3	3	3	3	3	3	3	2
14	10	9	8	7	7	6	6	6	6	5	5	4	4	4	4	4	4	3	3	3	3
15	11	10	9	8	8	7	7	6	6	6	5	5	5	4	4	4	4	4	4	4	3
16	13	11	10	9	9	8	8	7	7	6	6	6	6	5	5	5	5	5	5	4	4
17	14	13	12	11	10	9	9	8	8	7	7	6	6	6	5	5	5	5	5	5	4
18	16	14	13	12	11	10	10	9	9	8	8	7	7	6	6	6	6	6	6	5	5
19	18	16	15	14	13	12	11	10	10	9	8	8	8	7	7	7	6	6	6	6	5
20	20	18	16	15	14	13	12	11	11	10	9	9	9	8	8	7	7	7	7	6	6
21	22	20	18	17	15	14	13	12	12	11	10	10	10	9	9	8	8	7	7	7	7
22	24	22	20	18	17	16	15	14	13	12	12	11	11	10	10	9	9	8	8	7	7
23	26	24	22	20	18	17	16	15	14	14	13	12	11	11	10	10	9	9	9	8	8
24	29	26	24	22	20	19	18	17	16	15	14	13	12	11	11	10	10	9	9	9	9
25	31	28	26	24	22	21	19	18	17	16	15	14	13	12	12	11	11	10	10	10	9
26	34	31	28	26	24	22	21	19	18	17	16	15	14	13	13	12	12	11	11	10	10
27	36	33	30	28	26	24	22	21	19	18	17	16	15	15	14	13	13	12	12	11	11
28	39	35	32	30	28	26	24	22	21	20	19	18	17	16	15	14	14	13	13	12	12
29	42	38	34	32	30	28	25	24	22	21	20	19	18	17	16	15	15	14	14	13	13
30	45	41	37	34	32	29	27	25	24	22	21	20	19	18	17	16	16	15	15	14	14
31	48	44	39	37	34	31	29	27	25	24	23	22	21	19	18	18	17	16	16	15	15
32	51	46	42	39	36	33	31	29	27	25	24	23	22	21	20	19	18	17	17	16	16
33	54	49	44	41	38	35	33	31	29	27	25	24	23	22	21	20	19	19	18	17	17
34	57	52	47	44	41	38	35	33	31	29	27	25	24	23	22	21	21	20	19	18	18
35	60	55	50	46	43	40	37	35	33	31	29	27	25	24	23	23	22	21	20	19	19
36	64	58	53	49	45	42	40	37	35	33	31	29	27	26	25	24	23	22	21	20	20
37	67	61	56	52	48	45	42	38	37	35	32	31	29	28	26	25	24	23	22	21	21
38	71	65	59	55	51	47	44	41	39	36	34	32	31	29	28	27	26	24	23	22	22
39	75	68	62	58	53	50	46	43	41	38	36	34	32	31	29	28	27	26	24	24	23
40	79	72	66	61	56	52	49	46	43	40	38	36	34	32	31	30	29	27	26	25	24
41	83	76	69	64	59	55	51	48	45	42	40	38	36	34	33	32	30	29	27	26	25
42	87	80	73	67	62	58	54	50	47	44	42	40	38	36	35	33	32	30	29	28	27
43	91	84	76	70	64	60	56	53	49	47	44	42	39	38	36	35	33	32	30	29	28
44	96	88	80	73	67	63	59	55	52	49	46	43	41	39	38	36	35	33	32	30	29
45	100	92	83	77	70	66	61	58	54	51	48	46	43	41	40	38	36	35	33	32	30
46	105	96	87	80	74	69	64	60	57	54	51	48	45	43	42	40	38	36	35	33	32
47	109	100	91	84	77	72	97	63	59	56	53	49	47	45	43	42	40	38	36	35	33
48	114	104	95	87	80	75	70	65	61	58	55	52	50	47	45	43	42	40	38	36	35
49	119	109	99	91	83	78	73	69	64	61	57	55	52	49	46	45	43	41	39	38	36
50	124	113	103	95	87	81	76	71	67	63	60	57	54	51	48	46	45	43	41	39	38
51	129	117	107	98	91	85	79	74	69	66	62	59	56	53	50	49	47	45	43	41	39
52	134	121	111	102	95	89	83	77	72	68	65	61	58	55	53	51	49	47	45	43	41
53	139	126	115	106	98	92	86	80	74	71	67	64	60	58	55	53	50	48	46	44	42
54	144	131	120	110	102	95	89	83	77	73	70	66	63	60	57	54	52	50	48	46	44
55	149	136	124	114	106	99	92	6	80	76	72	69	65	62	59	57	54	52	49	47	45
56	155	141	129	119	110	103	96	89	83	79	75	71	68	65	62	59	56	53	51	49	47
57	160	146	133	123	114	107	99	93	86	82	77	74	70	67	64	61	58	55	53	51	49
58	166	151	138	127	118	110	103	96	90	85	80	76	73	69	66	63	60	57	55	53	51
59	172	156	143	133	123	115	106	100	93	88	83	79	75	72	68	65	62	59	57	55	53
60	178	162	148	137	128	119	110	103	97	91	86	82	78	74	70	67	64	61	59	56	54
61	184	167	153	141	131	122	113	107	100	94	89	85	80	76	72	69	66	63	61	58	56
62	190	173	158	145	135	125	117	110	103	97	92	87	83	79	75	72	69	66	63	60	58
	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°	21°	22°	23°	24°	25°	26°	27°	28°	29°	30°

TABLE XXVI. For computing the Effects of Parallax on the Moon's Distance from the Sun or a Star.

Parallax in Alt. or Diff.	Apparent Distance. Add the Difference of the two Numbers taken out of this Table, if the Apparent Distance is less than 90°, and subtract it if above.																			
	31°	32°	33°	34°	35°	36°	37°	38°	39°	40°	41°	42°	43°	44°	45°	46°	47°	48°	49°	50°	51°
M.	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
11	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
12	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
13	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1
14	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1
15	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1
16	4	4	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1
17	4	4	4	4	4	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2
18	5	5	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2
19	5	5	5	5	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	3
20	6	6	5	5	5	5	4	4	4	4	4	4	3	3	3	3	3	3	3	3	3
21	6	6	6	6	5	5	5	5	5	4	4	4	4	4	4	4	4	3	3	3	3
22	7	7	6	6	6	6	5	5	5	5	5	5	4	4	4	4	4	3	3	3	3
23	7	7	7	7	6	6	6	6	5	5	5	5	5	5	4	4	4	4	4	3	3
24	8	8	7	7	7	7	6	6	6	6	6	6	5	5	5	5	5	4	4	4	4
25	9	9	8	8	8	7	7	7	7	6	6	6	6	6	5	5	5	5	5	4	4
26	9	9	9	9	8	8	7	7	7	7	7	7	6	6	6	6	6	5	5	5	5
27	10	10	10	9	9	9	8	8	8	7	7	7	7	6	6	6	6	5	5	5	5
28	11	11	10	10	9	9	8	8	8	8	8	8	7	7	7	7	7	6	6	6	6
29	12	12	11	11	10	10	9	9	9	9	9	8	8	7	7	7	7	6	6	6	6
30	13	13	12	12	11	11	10	10	9	9	9	9	8	8	8	8	7	7	6	6	6
31	14	14	13	13	12	11	11	11	10	10	10	9	9	8	8	8	8	7	7	7	6
32	15	15	14	14	13	12	11	11	10	10	10	10	9	9	9	9	8	8	7	7	6
33	16	16	15	14	14	13	12	12	11	10	10	10	10	10	9	9	8	8	7	7	7
34	17	17	16	15	14	14	13	13	12	11	11	11	10	10	10	10	9	9	8	8	7
35	18	17	17	16	15	14	14	13	13	12	12	11	11	11	10	10	9	9	8	8	8
36	19	18	17	17	16	15	14	14	13	13	13	12	11	11	11	11	10	10	9	9	9
37	20	19	18	18	17	16	15	15	14	13	13	12	12	11	11	11	10	10	10	10	10
38	21	20	19	19	18	17	16	16	15	14	14	13	13	12	12	12	12	11	11	11	11
39	22	21	20	20	19	18	17	17	16	15	15	14	14	13	13	13	13	12	12	11	11
40	23	22	21	21	20	19	18	18	17	16	16	15	15	14	14	14	13	13	12	12	12
41	24	23	23	22	21	20	19	19	18	17	17	16	15	15	14	14	14	13	13	12	12
42	26	25	24	23	22	21	20	20	19	18	18	17	16	15	15	15	14	14	13	13	13
43	27	26	25	24	23	22	21	21	20	18	18	17	16	16	15	15	14	14	13	13	13
44	28	27	26	25	24	23	22	22	20	19	19	18	17	16	16	16	15	14	13	13	13
45	29	28	27	26	25	24	23	23	21	20	20	19	18	17	17	16	15	14	14	13	13
46	30	29	28	27	26	25	24	24	22	21	20	19	19	18	18	17	16	15	14	14	14
47	32	30	29	28	27	26	26	25	23	22	22	21	20	20	19	18	17	16	15	15	15
48	33	32	31	30	29	28	27	26	24	23	23	22	22	21	20	19	18	17	16	16	16
49	35	33	32	31	30	29	28	27	26	24	24	24	23	22	21	20	19	18	17	17	17
50	36	35	33	32	31	30	29	28	27	26	26	25	24	23	22	21	20	19	18	18	18
51	38	36	35	33	32	31	30	29	28	27	26	25	24	23	22	22	21	20	19	18	18
52	39	38	36	35	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	19	18
53	41	39	38	36	35	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	19
54	42	41	39	38	36	35	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
55	44	42	41	39	38	36	35	33	32	31	30	29	28	27	26	25	24	23	22	21	20
56	45	44	42	41	39	38	36	35	33	32	31	30	29	28	27	26	25	24	23	22	21
57	47	45	44	42	41	39	37	36	35	33	32	31	30	29	28	27	26	25	24	23	22
58	49	47	45	44	42	40	38	37	36	35	33	32	31	30	29	28	27	26	25	24	23
59	51	48	47	45	43	41	40	38	37	36	34	33	32	31	30	29	28	27	26	25	24
60	52	50	48	47	45	43	41	40	38	37	35	34	33	32	31	30	29	28	27	26	25
61	54	52	50	48	46	44	43	41	40	38	36	35	34	33	32	31	30	29	28	27	26
62	56	54	52	50	48	46	44	43	41	40	38	36	35	34	33	32	31	30	29	28	27
M.	31°	32°	33°	34°	35°	36°	37°	38°	39°	40°	41°	42°	43°	44°	45°	46°	47°	48°	49°	50°	51°

TABLE XXVI. For computing the Effects of Parallax on the Moon's Distance from the Sun or a Star.

Apparent Distance.
Add the Difference of the two Numbers taken out of this Table, if the Apparent Distance is less than 90°, and subtract it if above.

Parallax in Alt. or Dist.									120	115	110	105	100	95							
	52°	53°	54°	55°	56°	57°	58°	59°	60°	65°	70°	75	80°	85°	90°	95°	100	105	110	115	120
M.	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
13	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0						
14	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0						
15	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0						
16	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0						
17	2	2	2	1	1	1	1	1	1	1	0	0	0	0	0						
18	2	2	2	2	2	2	2	2	2	1	1	0	0	0	0						
19	3	2	2	2	2	2	2	2	2	1	1	0		0	0						
20	3	2	2	2	2	2	2	2	2	1	1	1		0	0						
21	3	3	3	2	2	2	2	2	2	1	1	1	0	0	0						
22	3	3	3	3	3	3	2	2	2	2	1	1	0	0	0						
23	3	3	3	3	3	3	3	3	2	2	1	1	0	0	0						
24	4	3	3	3	3	3	3	3	3	2	1	1	1	0	0						
25	4	4	4	3	3	3	3	3	3	2	1	1	1	0	0						
26	5	4	4	4	4	4	3	3	3	3	2	1	1	0	0						
27	5	5	5	4	4	4	4	4	3	3	2	1	1	0	0						
28	6	5	5	5	5	5	4	4	4	3	2	2	1	0	0						
29	6	5	5	5	5	5	4	4	4	3	2	2	1	0	0						
30	6	5	5	5	5	5	4	4	4	4	3	2	1	0	0						
31	6	5	5	5	5	5	5	5	4	4	3	2	1	0	0						
32	6	5	5	5	5	5	5	5	5	4	3	2	1	0	0						
33	6	6	6	5	5	5	5	5	5	4	3	2	1	0	0						
34	7	6	6	6	6	6	5	5	5	4	4	2	1	0	0						
35	8	7	7	6	6	6	6	6	5	4	4	2	1	0	0						
36	8	8	7	7	7	7	6	6	6	5	4	3	2	1	0						
37	9	9	8	8	8	7	7	7	6	5	4	3	2	1	0						
38	10	10	9	9	9	8	8	7	7	5	4	3	2	1	0						
39	11	10	10	9	9	9	8	8	7	5	4	3	2	1	0						
40	11	11	10	10	9	9	8	8	8	6	5	3	2	1	0						
41	12	12	11	10	10	10	9	9	8	6	5	3	2	1	0						
42	12	12	11	11	10	10	9	9	9	7	5	4	2	1	0						
43	12	12	11	11	10	10	9	9	9	7	5	4	2	1	0						
44	12	12	11	11	11	10	10	9	9	7	6	4	2	1	0						
45	13	12	12	11	11	11	10	10	9	7	6	4	2	1	0						
46	13	13	12	12	12	11	11	10	10	8	7	5	3	1	0						
47	14	14	13	12	12	12	11	11	10	8	7	5	3	1	0						
48	15	14	13	13	12	12	12	11	11	9	7	5	3	2	0						
49	16	15	14	14	14	13	13	12	11	9	7	5	3	2	0						
50	17	16	15	15	14	13	13	12	12	10	8	6	4	2	0						
51	17	16	16	15	15	14	14	13	12	10	8	6	4	2	0						
52	17	17	16	16	15	15	14	14	13	10	8	6	4	2	0						
53	18	18	17	16	16	15	14	14	13	10	8	6	4	2	0						
54	19	18	17	17	16	16	15	15	14	11	9	7	4	2	0						
55	19	18	18	17	17	16	16	15	14	11	9	7	4	2	0						
56	20	19	18	18	17	16	16	15	15	12	9	7	5	2	0						
57	21	20	19	19	19	18	17	16	15	12	9	7	5	2	0						
58	22	21	20	20	19	18	17	16	16	13	10	7	5	2	0						
59	23	22	21	21	20	19	18	17	17	13	10	7	5	2	0						
60	24	23	22	22	21	20	19	18	18	14	11	8	5	3	0						
61	25	24	23	23	22	21	20	19	18	15	11	8	5	3	0						
62	26	25	24	23	22	21	20	19	19	16	12	9	6	3	0						
M.	52°	53°	54°	55°	56°	57°	58°	59°	60°	65°	70°	75°	80°	85°	90°						

Table XXVI.

In working by the method shewn in page 238, should the distance of the objects be above 90 degrees, you must look in Table 26, with the Apparent Distance at the top, and the Moon's Correction on the left hand side column, the number found subtracted from 20, leaves the third correction.

In the same column, and corresponding to the difference of corrections, is another number, which, when subtracted from 20, leaves the fourth correction.

N. B. The different numbers found under 95°, 100°, 105°, 110°, 115°, 120°, &c. subtracted from 20, will leave the numbers as are in the little Table annexed.

Ta le XIII.—The first page contains the Proportional Parts of the Declination of the Sun to every five Minutes of Time, and every Degree and 15 Minutes of Longitude; and to every Minute, and every six Seconds of the daily Variation of the Sun's Declination.

The second and third page of the Table contains the Proportional Parts of the Sun's Declination to every Hour in the Day, and to every 15 Degrees of Longitude, and to every Minute and every six Seconds of the daily Variation of the Sun's Declination.

Ex. 1. I demand the proportional Part answering to six Hours, (or 90° of Longitude) when the Sun's daily Variation in Declination is 13 Minutes 24."

Under six Hours (or 90°) and opposite 13′ in left hand col. is......... 3′ 15″, 0
Under six Hours (or 90°) and opposite 24″, in left hand col. is ....0 6 , 0

Answer.........3 21, 0

Which is to be added or subtracted, according as the Sun's Declination is either encreasing or decreasing.

Ex. 2. What is the proportional Part answering to eight Hours 40′, (or 130° of Longitude, when the Sun's daily Variation in Declination) is 18 minutes and 42 seconds.

Under 8 Hours, & opposite to 18′ is 6′ 0″, 0
..................................42″ is 0′ 14″, 0
...... 40 minutes................18′ is 0′ 30″, 0
..................................42″ is 0′. 1″, 2

Answer ....6′ 45″, 2

Applicable as the first Example.

	95°	100	105	110	115	120
M.	″	″	″	″	″	″
5	20	20	20	20	20	20
8	20	20	20	20	20	20
10	20	20	20	20	20	20
11	20	20	20	20	20	20
12	20	20	20	20	20	20
13	20	20	20	20	20	20
14	20	20	20	20	19	19
15	20	20	20	20	19	19
16	20	20	20	20	19	19
17	20	20	20	20	19	19
18	20	20	20	19	19	18
19	20	20	20	19	19	18
20	20	20	19	19	19	18
21	20	20	19	19	19	18
22	20	20	19	19	18	18
23	20	20	19	19	18	18
24	20	19	19	19	18	17
25	20	19	19	19	18	17
26	20	19	19	18	17	17
27	20	19	19	18	17	17
28	20	19	18	18	17	16
29	20	19	18	18	17	16
30	20	19	18	17	16	16
31	20	19	18	17	16	16
32	20	19	18	17	16	15
33	20	19	18	17	16	15
34	20	19	18	16	16	15
35	20	19	18	16	16	15
36	19	18	17	16	15	14
37	19	18	17	16	15	14
38	19	18	17	16	15	13
39	19	18	17	16	15	13
40	19	18	17	15	14	12
41	19	18	17	15	14	12
42	19	18	16	15	13	11
43	19	18	16	15	13	11
44	19	18	16	14	13	11
45	19	18	16	14	13	11
46	19	17	15	13	12	10
47	19	17	15	13	12	10
48	18	17	15	13	11	9
49	18	17	15	13	11	9
50	18	16	14	12	10	8
51	18	16	14	12	10	8
52	18	16	14	12	10	7
53	18	16	14	12	10	7
54	18	16	13	11	9	6
55	18	16	13	11	9	6
56	18	15	13	11	8	5
57	18	15	13	11	8	5
58	18	15	13	10	7	4
59	18	15	13	10	7	3
60	17	15	12	9	6	2
61	17	15	12	9	5	2
62	17	14	11	8	4	1
M.	95°	100°	105	110	115	120

LATITUDES AND LONGITUDES

OF THE

PRINCIPAL PORTS, HARBOURS, CAPES, SHOALS, ROCKS, &c. IN THE WORLD;

Deduced from the Obfervations of the moft celebrated Navigators and Aftronomers; compared with the lateft and moft accurate Charts, Maps, &c.

The Longitudes are reckoned from the Meridian of Greenwich.

Coafts of Great Britain and Iflands adjacent.

South Coaft of England.

Places.	Lat. D.	M.	S.	Long. D.	M.	S.
LONDON (St. Paul's)	51	30	49N.	0	5	47W.
Greenwich Obf.	51	28	40	0	0	0
Nore	51	28	0	0	46	0 E.
No. Foreland Light	51	22	40	1	26	22
Deal Caftle	51	13	5	1	23	59
S. Foreland Lighth.	51	8	26	1	22	6
Dover Caftle	51	7	47	1	19	7
Dungenefs Lighth.	50	55	1	0	57	48
Haftings	50	52	0	0	35	0
Beachy Head	50	44	23	0	15	12
Seaford	50	47	20	0	7	0
Brighton Church	50	49	32	0	11	55W.
Shoreham	50	49	59	0	16	19
Arundel	50	49	0	0	35	15
Owers Light	50	39	57	0	39	15
Selfey Bill	50	44	5	0	48	0
Portfmouth Church	50	47	26	1	5	57

Ifle of Wight.

Places.	Lat. D.	M.	S.	Long. D.	M.	S.
Bembridge Point	50	40	59N.	1	4	25W.
Princeffa Shoal, S.B.	50	39	30	1	4	25
Dunnofe Point	50	37	7	1	11	36
St. Catherine's Tower	50	35	33	1	17	51
Needles Light	50	39	53	1	33	55
Cowes	50	45	37	1	16	15
Hurft Lighthoufe	50	42	23	1	32	50
Chrift Church Head	54	43	57	1	45	10
BrankfeaCaft. (Pool)	50	41	19	1	57	1
St. Alban's Head	50	33	30	2	2	0
Weymouth	50	36	15	2	26	40
Shambles Shoal, Mid.	50	32	0	2	22	0
Portland Uplight	50	31	32	2	26	50
Lyme Cob	50	43	10	2	55	29
Berry Head, F. S.	50	24	0	3	28	14
Dartmouth	50	22	0	3	34	0
Start Point, F. S.	50	13	26	3	38	0
Bolt Head, F. S.	50	13	15	3	48	3
Rame Head	50	18	52	4	12	29
Plymouth Old Ch.	50	22	13	4	7	32
Eddyftone Lighth	50	10	54	4	15	2
Deadman's Pt F. S.	50	13	20	4	47	8
Pendennis Caftle	50	8	49	5	1	44

Places.	Lat. D.	M.	S.	Long. D.	M.	S.
Blackhead, F. S.	50	1	12N.	5	4	0W.
Lizard Point	49	57	40	5	11	46
Mount's B. (Penz.)	50	7	40	5	31	0
Runnel Stone	50	1	20	5	39	0
Wolf Rock	49	57	20	5	47	45
Land's End (Stone)	50	4	7	5	41	32
Longfhips Lighth.	50	4	20	5	44	30
S. Martin's Day-mark	49	58	29	6	14	39
St. Agnes Lighth.	49	53	37	6	19	23
Seven Stones	50	6	20	5	47	20

Weft Coaft of England.

Places.	Lat. D.	M.	S.	Long. D.	M.	S.
Cape Cornwall	50	7	50N.	5	42	0W.
St. Ives Point	50	13	20	5	26	0
Cow and Calf	50	32	45	5	2	22
Port Ifaac	50	36	0	4	16	0
Hartland Point	51	1	0	4	25	0
Barnftable	50	7	20	4	3	0
Mort Pt. So. Entrance of Briftol Channel	51	12	0	4	7	0
Lundy Ifland	51	13	0	4	32	0
Flatholm Lighthoufe	51	25	0	3	7	0
*Briftol	51	27	6	2	35	29
Nefs Point	51	29	30	3	31	50
Mumble's Light	51	36	45	3	55	0
Worms Head	51	35	25	4	13	0
Caldy Ifland	51	44	20	4	26	30
St. Gowan's Point	51	40	10	4	47	0
St. Ann's Lights	51	43	45	5	1	0
Small's Lighthoufe	51	45	40	5	28	0
Hatts and Barrels	51	45	15	5	20	15
St. David's Head	51	55	0	5	8	0
Strumble's Head	52	1	15	5	0	0
Dinas Point	52	1	10	4	50	0
Cardigan Ifland	52	7	45	[illegible]	30	0
New Key Head	52	10	40	4	19	0
Aberiftwith	52	21	30	3	59	0
Aberdovey	52	33	0	4	0	0
Barmouth	52	42	30	4	0	0
Penkellan Head	52	47	30	4	32	0
Bardfey Ifland, So. Pt	52	44	30	4	46	30
Porthdinlleyn Head	52	56	30	4	34	0

Names of Places.	Lat. D. M. S.	Long. D. M.
Holyhead Ifl. W. P.	53 18 45N.	4 40 30W.
Skerries Lighthoufe	53 24 50	4 36 30
Point Linas Light	53 24 30	4 17 45
Great Orms Head	53 20 0	3 50 20
Point of Ayr Lighth.	53 21 0	3 16 0
Lake Lights	53 23 0	3 8 0
Liverpool	53 23 30	2 27 0
Formby Point	53 35 45	3 5 0
Lancafter	54 3 0	2 51 0
Selker Rock	54 16 30	3 27 0
St. Bees Head Lighth.	54 30 15	3 42 15
Whitehaven	54 32 30	3 34 45
Workington	54 38 0	3 30 0
Mary Port	54 43 0	3 27 0
Carlifle	54 55 45	2 55 30

Ifle of Man.

Calf of Man	54 2 0N.	4 50 0W.
Point of Air	54 24 30	4 22 30
Ramfey	54 19 30	4 26 0
Douglafs	54 8 30	4 30 0

Weft and North Coaft of Scotland.

Rofs	54 46 30N.	4 8 0W.
Burrow Head	54 41 30	4 27 0
Great Scar Ifland	54 40 30	4 46 0
Mull of Galloway	54 37 45	4 56 0
Port Patrick Lighth.	54 48 0	5 8 0
Elfa Ifland	55 16 15	5 12 8
Air Lighthoufe	55 26 30	4 44 0
Pladda Ifland Lights	55 27 0	5 11 0
NorthPoint ArranIfl.	55 40 0	5 20 0
Cumry Ifland Light	55 46 20	5 16 0
Greenock	55 58 0	5 6 0
M. of Cantire Lighth.	55 18 30	6 0 0
Gia Ifland, North End	55 45 0	6 1 0
Run's Point, Ila Ifl.	55 47 0	6 44 0
Touvore Head, Ditto	55 54 0	6 45 0
Skerryvore Rocks	56 15 45	7 24 0
Dufkier Rock	56 34 0	7 20 0
Tire-ey-Ifle, N W.P.	56 33 0	7 16 0
Helfker Iflands	56 56 0	6 59 0
Sunk Rocks, to the weftward of Helfker	56 55 0	7 8 0
Coll Ifland, Eaft End	56 41 0	6 43 0
Rum Ifland, Eaft End	57 0 0	6 30 0
Cana Ifland, Eaft Pt.	57 3 0	6 44 0
Donvegan Head	57 32 0	7 4 0
Valernefh Point	57 35 20	6 54 0
Rea Head	57 50 0	6 2 0
More Head	58 4 40	5 39 0
Stower Head	58 13 30	5 37 0
Cape Wrath	58 36 0	5 19 0
Rona Ifland	58 54 45	6 16 0
Bara, or Sulifker Ifl.	58 54 0	6 28 0
Far-out Head	58 39 0	4 55 0
Dunnet Head	58 42 0	3 27 0
Duncansley Head	58 40 0	3 8 0

Lewis Iflands.

Names of Places.	Lat. D. M. S.	Long. D. M.
Bernera Ifland	56 48 0N.	7 56W
Grien Head, Bara Ifland	57 0 0	7 53
Ruardvula, So. Uift Ifl.	57 12 0	7 49
Hyfkere Ifland, W. P.	57 28 30	8 0
Cafamul Ifland	57 34 20	8 0
Rennifh Head	57 41 0	7 16
Toe Head	57 49 30	7 25
Glafh Ifland Light	57 50 0	6 56
Gallen Head	58 10 30	7 24
Flannen Ifles	58 14 0	7 51
St. Kilda Ifle	57 50 0	8 18
Aird Point	58 15 0	6 24
*But of the Lewis	58 28 30	6 34

The Orkney Iflands.

Pentland Skerries	58 42 30N.	3 2W
Stroma Ifland, S. End	58 43 0	3 12
South Ronoldfha, S. Po.	58 45 0	3 4
Copinfhaw	58 56 0	2 46
Stronfa Ifland, Lamb H.	59 6 30	2 38
Trefsnefs, Sanda Ifle	59 15 30	
Start, .. Ditto	50 19 0	
North Ronoldfha Light	59 25 30	2 36
Mould Head, Pappa Weftra Ifland	59 23 0	3 1
Noup Head, Weftra Ifle	59 20 30	3 9
Marwick H. Pomona I.	59 6 0	3 22
Stromnefs, Pomona Ifle	58 58 30	3 28
Hoyhead Head, Hoy-walls Ifland	58 57 0	3 22
The Stack	59 2 0	
Sule Skerry	59 3 10	
Fair Ifland	59 29 30	1 45

Shetland Ifles.

Suenburgh Head	59 52 0N.	1 25W
Hang Cliff	60 7 0	0 50
Braffa Sound, Lerwick	60 10 0	0 53
Whalfey Ifland	60 25 0	0 39
Unft Ifland, N. E. Point	60 42 30	0 0
Foul Ifland	60 25 0	1 23

Ferro Ifles.

Monk Rock, which appears like a Sail	61 18 0N.	6 31W
Fulae Ifland	62 14 30	6 10
Mygenefs Ifland, E. Po.	62 4 30	7 20

Eaft Coaft of Scotland and England.

Nofs Head	58 32 30N.	3 8W
Clythnefs	58 23 0	3 15
Ord Head	58 12 30	3 37
Tarbet Nefs	57 55 45	3 49

ames of Places.	Lat. D.	M.	S.	Long. D.	M.	
marty ...	57	42	30N.	4	1	0W
rnefs	57	32	0	4	8	0
George ...	57	38	0	4	6	0
gh Head ..	57	44	30	3	31	0
aird's Head Lt.	57	39	30	2	1	0
r Head ...	57	32	0	1	47	0
han Nefs ..	7	29	30	1	47	0
Aberdeen ..	57	9	0	2	9	0
trofe ...	56	12	45	2	29	0
head ...	56	37	30	2	32	0
roath	56	34	30	2	38	0
Rocks Light ..	56	26	30	2	27	0
tonefs Lights ...	56	29	15	2	46	0
ndee	56	29	0	2	59	0
Andrew's ..	56	21	0	2	50	0
e Nefs ..	56	17	0	2	38	0
y Ifland Light .	56	11	15	2	39	0
INBURGH ..	55	57	15	3	13	0
he Bafs ...	56	6	0	2	42	0
unbar ...	56	1	30	2	34	0
Abbs Heads	55	56	0	2	11	0
erwick ..	55	48	30	2	6	0
ocky Bank, Mid. .	56	11	0	2	11	0
Holy Ifland, N E.P.	55	43	30	1	53	0
amburgh Caftle ..	55	39	0	1	43	0
taple's Light ...	55	40	0	1	43	0
ern Ifland Light...	55	38	0	1	45	0
oquet Ifland ...	55	22	30	1	30	0
inmouth Light ...	55	4	0	1	20	0
Hartlepool ..	54	44	30	1	7	0
tockton	54	36	0	1	18	0
Whitby ...	54	28	30	0	50	0
carborough ...	54	20	0	0	23	0
iley Brig ...	54	16	30	0	11	0
Flamborough Head	54	10	30	0	3	0E.
Purn Lights ..	53	39	0	0	24	0
uter Dowfings, N.						0
W. end	53	44	30	1	18	0
addock Bank ...	53	46	0	1	39	0
hoal to the Weftward						0
of Outer Dowfing	53	44	0	1	35	0
udgeon Lights ..	53	30	0	1	7	0
ner Dowfing ..	53	20	30	0	42	0
omer Bank ..	53	25	0	1	34	0
emon and Owers, M.	53	21	0	1	58	0
Herringham Shoal	53	9	30	2	2	0
afborough Sand, S.						0
Buoy .	53	0	0	1	53	0
ammond's Knowl	52	58	0	1	59	0
mith's Knowl, Buoy	52	59	0	2	26	0
he Ridge	53	0	0	2	43	0
omer Lights ...	53	6	0	1	26	0
armouth ..	52	39	0	1	44	0
oftoff Lights ..	52	29	20	1	46	30
uthwold ..	52	20	0	1	42	35.
bro' Napes ..	52	9	0	1	43	0
fordnefs ..	52	5	0	1	34	14
entifh Knock ...	51	42	30	1	36	30

West Coast of Ireland.

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	
ape Clear .	51	22	30N.	9	30	0W
aftnet Rock .	51	19	30	9	34	0
rookhaven ..	51	26	30	51	41	40
Mizzen Head ..	51	27	0N.	9	47	0W
Bantry B. Sheep's H.	51	34	0	9	49	0
Grelagh Rocks ..	51	31	30	10	8	0
Durfey Ifle, W. end	51	36	0	10	12	0
Bull Rock ..	51	37	0	10	16	0
Cod's Head ...	51	42	0	10	5	0
Hog Iflands ...	51	47	0	10	14	0
Bolus Head	51	50	45	10	18	45
Skelling's Rock .	51	50	0	10	31	0
Lemon Rock ..	51	52	0	10	25	0
— Bray Head ...	51	57	0	10	24	0
— Dunmore Head..	52	10	0	10	24	0
Foze Rock	52	5	0	10	37	0
Ferriter's Ifland....	52	7	0	10	32	0
Tiraght Rocks ...	52	8	30	10	25	0
Great Blafket, W. end	52	8	30	10	29	0
Ennis Tufkar	52	12	30	10	30	0
Dunorling Head ...	52	17	0	10	19	30
Brandon Head ..	52	22	0	10	8	0
— Kerry Head ..	52	30	0	9	54	0
— Loop Head Light	52	37	0	9	54	0
Limerick ...	52	42	0	8	42	0
Ballards Point ...	52	42	30	9	54	0
Hags Head ..	52	55	0	9	42	0
— Black Head ...	53	6	30	9	28	0
— Galway	53	15	0	9	11	0
N Arran Ifle, W. End	53	7	0	10	3	0
Skird Rocks ...	53	16	0	10	18	0
Sline Head	53	25	30	10	29	0
Shark Ifle	53	36	45	10	36	0
Ennis Turk I. ...	53	42	0	10	24	0
Cla e Ifland, Weft End	53	46	15	10	18	0
Achill Head ...	53	58	30	10	30	0
Black Rock ...	54	5	0	10	35	0
Urris Head ..	54	20	30	10	18	0

North Coast of Ireland.

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	
Kid Ifles ...	54	22	0N.	10	8	0W
Three Tuns Rocks .	54	23	30	10	4	0
Down Patrick Head.	54	21	0	9	36	0
Killala	54	13	30	9	27	0
Sligo	54	16	45	8	41	0
Wheaten Rock ..	54	21	15	8	55	0
Donnegal ...	54	38	30	8	14	0
Tellen Head	54	41	30	8	58	0
Douras Head . ..	54	51	0	8	42	0
Arranmore I. N. End	55	5	45	8	36	0
Bloody Foreland ..	55	10	30	8	17	0
Tory Island ...	55	17	45	8	11	0
Horn Head	55	14	0	7	57	0
Mulloy	55	17	0			0
Bucan's Head ...	55	17	45	7	47	0
— Dunaff Head ...	55	17	30	7	32	0
Mullin Head ..	55	24	0	7	24	0
Ennifirahul Rocks..	55	29	15	7	11	0
Colodah Head ...	55	22	0	7	7	0
Inifhon : Head ...	55	15	45	6	51	0
Londonderry .	55	1	0	7	16	0
Giants Caufeway ...	55	17	30	6	20	0
Rachlin I. W. End	55	21	15	6	8	0
Fair Head ..	55	14	45	6	4	0
Tor Head	55	13	30	6	1	0

East Coast of Ireland.

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	
Maids Rocks ..	54	57	20N.	5	37	0W
Black Head ...	54	46	30	5	35	0
Carrickfergus ...	54	42	20	5	45	0
Belfast ...	54	34	30	5	56	0
Mew Isle and Light.	54	40	45	5	23	0
South Rock Light .	54	20	50	5	22	0
Dundrum	54	13	15	5	50	0
Newry ...	54	5	30	6	12	0
Dundalk ...	53	58	30	6	16	0
Clougher Head ...	53	49	30	6	20	0
Drogheda Bar ..	53	44	0	6	14	0
St. Patrick's Island .	53	35	20	5	57	0
Lambay Island ..	53	30	0	5	56	0
Howth Head Light .	53	22	30	6	3	0
DUBLIN ...	53	21	45	6	16	0
Wicklow Lights ..	52	59	0	6	1	0
Arklow ...	52	50	0	6	7	0
Glascarrick	52	39	15	6	10	0
Wexford ...	52	22	30	6	17	0

South Coast of Ireland.

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	
Carnsore Point	52	12	30N.	6	7	0W
Tusker Rock ...	52	14	0	5	58	0
Saltees Rocks ...	52	6	0	6	23	0
Hook Light	52	4	30	6	45	0
Waterford	52	13	0	7	59	0
Tramore ...	52	7	0	6	59	0
Dungarven	52	4	0	7	29	0
Urdmore, or Ram Hd	51	58	30	7	33	0
Youghall	51	57	0	7	41	0
Dogs Nose ...	51	48	30	8	9	0
Cork	51	55	30	8	25	0
Kinsale, Old Head..	51	38	30	8	27	0
Seven Heads ..	51	36	0	8	35	0
Dundedy Head ...	51	34	0	8	57	0
Ross ...	51	37	0	8	56	30
Stags off Toe Head .	51	29	0	9	8	0
Baltimore ..	51	30	0	9	20	0

Coast of Holland and Jutland, from Calais to the Scaw.

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	
Calais	50	57	30N.	1	50	56E.
Gravelines ...	50	59	15	2	10	0
Dunkirk ...	51	2	11	2	22	0
Newport	51	8	20	2	45	0
Ostend	51	15	30	2	55	0
Walcheren I. West P.	51	32	0	3	24	0
Goree Island, N.W P.	51	49	0	3	50	0
Schowen Isl. Lights.	51	40	45	3	37	0
Bruges	51	13	30	3	13	0
North Gatt	51	54	20	4	5	0
Rotterdam	51	54	0	4	29	0
AMSTERDAM ..	52	22	0	4	51	30
Texel, N. Point ...	53	11	20	4	34	0
Bremen	53	3	30	8	51	0
Elbe River, Red B.	53	59	15	8	18	0
Heiligeland Light ..	54	9	30	8	0	0
Holmen	57	8	30	8	35	0
Robsnout	57	27	30	9	39	0
Scaw	57	41	45	10	39	0

Cattegat and Sound.

Names of Places.	Lat. D.	M.	S.	Long. D.	M.
Paternosters ...	57	55	0N.	11	27E.
Marstrand Light ..	57	54	0	11	35
Wingo Beacon ...	57	38	45	11	37
Gothenburgh ...	57	42	30	11	59
Lessiou I. East Point ..	57	18	45	11	10
——— West P. .	57	15	0	10	50
Trindel Rock ..	57	19	0	11	7
Grasholm ...	57	29	0	10	36
Suitringen Shoal ...	57	0	0	10	29
Niddingen Lights ...	57	18	0	11	55
Warberg ...	57	6	30	12	16
Rocky Shoal, Little M. Ground ...	56	57	20	12	0
Falkenburgh	56	54	20	12	29
Halmsted	56	40	30	12	52
Anholt Light ...	56	45	0	11	40
Knobbin ...	56	45	0	11	53
Waderoe I. West P.	56	28	0	12	33
Koll Light ..	56	19	20	12	27
Lysle Ground ...	56	19	0	11	48
Hisell Island ...	56	12	0	11	42
Stains Head ...	56	35	20	10	51
Granan	56	25	0	10	55
Chalk Ground, Shoal	56	25	0	11	52
Navaren Shoal ...	56	23	30	11	0
Jesness Ground, Shoal	56	17	0	10	53
Hastens Ground, Ditto	56	15	0	11	10
Nackehovet Lights ..	56	6	30	12	21
Cronenburgh Light .	56	3	20	12	37
Elseneur ..	56	1	0	12	35
Huen I. North P. ...	55	55	20	12	40
Saltholm, North P. .	55	41	30	12	48
Lansdscrone	55	52	20	12	51
COPENHAGEN .	55	40	30	12	35
Falsterbro Light .	55	21	20	12	48

Baltic or East Sea.

Names of Places.	Lat. D.	M.	S.	Long. D.	M.
Lubeck ...	53	51	30N.	10	47E.
Dars Head	54	28	0	12	36
Bornholm Lt. N.W. P.	55	14	30	14	46
——— West P.	55	8	20	15	17
Dantzick Heel ...	54	38	0	18	40
Dantzick	54	21	45	18	31
Oland Light, South P.	56	11	20	16	25
——— North P.	57	23	0	17	5
Gothland, South P. ..	56	54	0	18	16
——— North P. ..	57	50	30	18	54
Faro I. N. E. P. ...	57	55	20	19	31
Goltske I.	58	16	0	19	21
STOCKHOLM ..	59	18	45	17	52
Bruster Ort Lights .	54	52	30	19	54
Memel	55	41	0	21	1
Domesness Lights ...	57	45	30	22	31
Runoe Light	57	48	20	23	8
Riga	56	57	0	23	56
Swafverort Light ...	57	54	30	21	59

Gulf of Finland.

Names of Places.	Lat. D. M. S.	Long. D. M.
Dagerort Point ...	58 57 30N.	22 1 E.
Odenholm Iflands ...	59 19 0	13 21
Hango Ifland and Light	59 49 0	23 20
Packerort Light ..	59 24 30	24 5
Surp Point and Light	59 28 10	24 28
Kafch Skar Light ...	59 38 20	25 9
Hoogland Ifland, N. end	59 58 0	27 7
See Skar Ifland, N. end	59 56 25	28 30
Wyburgh ...	69 40 0	29 55
Tol Beacon Light ..	60 1 0	29 40
Cronftad	59 57 30	29 54
PETERSBURGH....	59 58 40	30 20

The Coaft of Norway and Lapland, from Chriftiana to Archangel.

Names of Places.	Lat. D. M. S.	Long. D. M.
Chriftiana ...	59 52 45N.	10 52E.
Frederickftad ..	59 10 15	11 2
Stromftad ...	58 55 10	11 13
Faerder Light	59 2 35	10 39
Arundal	58 40 0	8 57
Chriftanafand ...	58 19 0	8 14
Naze	58 7 20	7 15
Walbert's Head ..	58 32 0	5 56
Bommel Head ...	59 31 30	5 0
Ulfter's Iflands ...	59 24 0	4 50
Bergen	60 14 0	5 11
Ronde Light ...	62 22 0	5 40
Drontheim	63 26 30	10 20
Werro Ifland ..	67 40 0	11 26
North Cape ..	71 9 45	26 1
North Kyne Cape ..	71 6 10	27 44
Wardhur's Ifland ...	70 30 30	30 40
OifterHaven, Fifher's I.	70 3 0	31 41
Terrybem Point ..	69 10 20	33 58
Nagle Ifland, N. Point	68 33 12	35 40
Cape Sweetnofe	67 58 45	37 30
Lambachoe Point ...	67 34 30	38 30
Cape Orlogenofe ..	67 1 35	39 21
Crofs Ifland, N. Point	66 21 0	38 45
Onega	63 36 0	37 20
Cape Donega ...	64 45 20	35 42
Archangel ...	64 30 30	38 59
Blue Point	65 19 20	38 5
Cape Bona Fortuna ..	66 24 10	40 24
Morfham Ifland, M.	66 39 20	40 40
Cape Candinofe	68 22 30	41 25
Nova Zembla ...	78 6 0	76 20

The Coaft of Greenland.

Names of Places.	Lat. D. M. S.	Long. D. M.
John Mayen's Ifld. ...	71 10 25N.	9 50W
Gael Hamkes Bay ..	75 0 40	6 51
Bontokoe Ifland	73 27 20	9 36
Charn Point	70 5 15	22 23
Dangy Ifland	67 23 10	27 25
Herjoifs-Nefs	65 3 0	30 25
Whales Ifland	62 30 5	39 9
Cape Difcord	60 51 0	40 0
Cape Prince Chrift. ...	59 55 45	41 35
Cape Farewel	59 38 30	42 44
Cape Defolation	62 0 9	46 12

The Coaft of Iceland.

Names of Places.	Lat. D. M. S.	Long. D. M.
Reikianefs Cape ..	63 55 10N.	22 45 0W
Weftman's Ifland ..	63 2 25	21 9 0
'airixford	65 36 6	24 9 0
straumnefs ...	65 40 13	24 30 0
North Cape ...	56 34 20	23 10 0
Grims Ifland ..	67 0 30	21 46 0
Rikefiord ..	67 0 45	17 35 0
Longnofe ...	56 45 10	12 19 0
Blaanefs ...	66 2 15	12 21 0
Enchuifen Ifland ..	65 0 25	10 5 0
Engelhoaft	64 32 10	12 19 0
Areeland Ifland	64 5 5	13 19 0
Cape Hekla	63 22 20	16 54 0

Davis's Straits.

Names of Places.	Lat. D. M. S.	Long. D. M.
Cape Riefoluton ..	62 40 20N.	46 43 0W
Cape Comfort ..	62 45 45	47 35 0
Hope Harbour ...	63 55 0	47 55 0
Gilbert's Sound ..	64 15 20	47 58 0
Cooken Sound ...	64 50 16	48 3 0
K. Chriftian River	66 7 25	47 13 0
Mufketo Cove .	64 55 30	52 56 0
Romel Fort ..	67 22 15	45 58 0
Difco I. S.W.Point	69 6 45	44 43 0
Waygate Ifland ...	70 40 50	44 13 0
James I. C.Bedford	68 30 0	50 12 0
Cumberld.I. S. Point	66 0 12	60 35 0
Bay of Good Fortune	64 20 25	61 34 6
Refolution Ifland ..	62 5 15	64 35 0
Cape Warwick ...	61 4 0	64 35 0

Coaft of France, Spain, and Portugal, from Calais to Gibraltar.

Names of Places.	Lat. D. M. S.	Long. D. M. S.
Calais ..	50 57 30N.	1 50 56E.
Cape Grifnefs ..	50 52 30	1 35 30
Boulogne ...	50 43 30	1 36 30
Etaples ...	50 31 0	1 38 0
St. Val. fur Somme	50 11 0	1 38 0
Dieppe ..	49 55 15	0 4 0
St. Valery in Caux	49 52 30	0 4 0
Fecamp ...	49 46 0	0 21 0
Cape de Caux ...	49 42 30	0 11 0
Cape de la Heve Lt.	49 30 30	0 4 10
Havre ...	49 29 15	0 6 0
Hontfleur ...	49 25 0	0 15 0
PARIS .	48 51 15	2 20 15
Point de Conebar .	49 22 30	0 31 30W
Pt. de la Percée ..	49 23 25	0 56 0
St. Marcou, Ifland.	49 29 49	1 8 50
Cape Barfleur Light	49 41 45	1 16 30
Cherbourg .	49 38 29	1 37 0
Cape la Hague	49 43 33	1 55 30
Alderney I. N. end	49 45 0	2 10 50
Cafket Lights .	49 45 0	2 25 50
GuernfeyI.S.Pierre	49 29 0	2 33 0
Sark I. Windmill	49 23 32	2 24 45
Jerfey I.CapeGriff-nefs ...	49 15 15	2 14 0
— St. Aubin ..	49 10 50	2 10 30

[Nam]es of Places.	Lat. D.	M.	S.	Long. D.	M.	
[...]ier	49	10	45N.	2	15	0W
[...]ſey I Middle	48	52	20	1	49	10
[...]tances	49	2	50	1	27	25
[...] Margaret	48	56	10	1	32	30
[...]anville Light	48	50	13	1	36	4
[...]ranches	48	41	0	1	20	0
[M]ount St. Michael	48	38	0	1	30	0
[St] Malo	48	39	1	2	1	14
[T]owerde laConche	48	41	4	2	2	40
[C]ape Frehel Light	48	41	5	2	18	47
St Brieux	48	31	0	2	42	30
Brehat I. North end	48	51	20	2	55	45
Rock Douver, Mid.	49	5	20	2	53	0
Seven Island Mid.	48	55	0	3	24	0
TriangleRocks, E.e.	48	54	0	3	36	0
Rock Blanch	49	1	30	3	56	50
Iſle of Bas N. end	48	45	40	4	0	0
Le Four Iſle	48	36	0	4	45	30
Uſhant Light	48	28	8	5	3	6
Point Matthews	48	19	34	4	45	39
Breſt	48	22	42	4	29	4
Point Raz	48	4	0	4	45	0
Saints Rocks	48	5	0	5	3	15
Point L'Abbe	47	48	40	4	23	0
Glenan Iſlands	47	42	0	4	0	0
Quimperlay	47	51	53	3	33	0
L'Orient	47	44	30	3	22	0
Quiberon, S. Point	47	28	0	3	4	0
Iſle de Groas, E.Pt.	47	37	0	3	24	0
Belle Iſle, N. end	47	22	50	3	14	55
HouatIſland, Middle	47	23	0	2	57	42
Hedic Iſland	47	20	45	2	51	5
Iſle deDieu, N.W.e.	46	43	0	2	24	0
Auray	47	39	10	2	58	5
Vannes	47	39	14	2	44	45
Croiſic	47	17	9	2	28	30
Nantes	47	12	45	1	32	45
Noirmouſtier I.N.e	47	2	0	2	17	20
St. Gilles	46	41	30	1	56	0
Roche Bon	46	16	0	2	24	0
Iſle of Rec, Light	46	14	49	1	33	25
Iſle of Oleron N.P.	46	3	0	1	24	45
Cordova Light	45	35	14	1	9	55
Royan	45	3	0	1	2	0
Bourdeaux	44	51	0	0	34	0
C. Feret	44	40	0	1	16	30
C. Breton	43	39	0	1	25	0
Bayonne	43	28	30	1	28	26
St. Jean de Luz	43	24	0	1	30	0
C Machicaco	43	29	0	2	40	0
Bilboa	43	15	20	2	43	0
C. Mayor	43	30	0	3	38	0
St. Vincent	43	23	0	4	15	0
Villaviciofa	43	34	0	5	20	0
Gijon	43	35	0	5	38	0
C. Penas	43	43	0	5	48	0
Aviles	43	35	0	5	53	0
Rebadeo	43	33	10	7	2	0
C Ortegal	43	46	37	7	51	0
C. Finiſterre	42	53	0	9	16	15
C. Corobedo	42	39	0	9	10	30
Vigo	42	14	0	8	39	45
Vienna	41	47	0	8	43	0
Oporto	41	9	0	8	45	0
C. Mondego	40	10	50	8	52	0

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	
C. Feſaraon	39	31	0N.	9	4	
Burlings	39	28	0	9	23	
Liſbon Rock (Cape)	38	45	15	9	26	
Liſbon	38	42	0	9		
C. Spichel	38	25	0	9	1[...]	
St Ubes	38	31	0	8	4[...]	
Sines	37	55	0	8	4[...]	
C. St. Vincent	37	2	30	9		
Lagos	37	8	30	8	3	
C St Mary	36	56	0	7	5	
Pt des Humbria	37	5	45	7		
Pt Avenilla	37	5	6	6		
St. Lucar	36	45	0	6	1	
Seville	36	59	0	5		
Cadiz	36	32	0	6		
C. Trefalgar	36	10	0	6		
Gibraltar, EuropaPt.	36	6	30	5		

North Coaſt of the Mediterranean.

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	S.
Malaga	36	43	30N.	4	21	0W
Modrill	36	44	50	3	32	0
Almeria	36	51	0	2	30	0
C. de Gatt	36	43	50	2	12	50
Point Cape	37	25	20	1	26	0
Carthagena	37	35	40	1	0	0
Cape Pallas	37	36	30	0	41	15
Alicant	38	20	41	0	28	10
C. St. Martin	38	47	20	0	12	30E.
Denia	38	52	20	0	5	0
Valencia	39	26	0	0	18	30W
C. Oropeſo	40	6	0	0	8	8E
RiverEbro, Entrance	40	43	0	0	55	0
Terragona	41	10	30	1	17	0
Barcelona	41	23	8	2	10	0
C. St. Sebaſtian	41	53	0	3	13	0
Bay of Roſes	42	14	0	3	11	
Cap Creux	42	19	10	3	21	
Collioure	42	31	45	3	5	
Perpignan	42	42	0	2	56	
Narbonne	43	11	20	3	1	
Agde	43	19	0	3	28	
Fort Brecon	43	16	30	3	3[...]	
Cette Lights	43	23	30	3	4	
Montpelier	43	37	0	3		
Aigues Light	43	32	30	4		
Tour de Bouc	43	22	30	5		
Marſeilles	43	17	50	5		
La Ciotat	43	10	20	5		
Toulon	43	7	16	5		
Hieres	43	7	45	6		
Gien	43	2	30			
C. Taillar	43	8	0			
Frejus	43	26	0			
St. Tropez	43	17	0			
C. Gros	43	32	0			
Cannes	43	33	0			
Antibes	43	34	40			
St. Marguerite, Iſland	43	31	20			
Nice	43	42	0			
Villa Franche Light	43	40	30			
Cape Melle	43	58	0			
Savona	44	17	20			
Genoa	44	24	50			

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	
Rappallo	44	20	0N.	9	17	0E.
Point Venere	44	2	0	9	46	0
Pisa	43	43	0	10	23	0
Florence	43	46	35	11	15	0
Leghorn	43	33	0	10	16	30
C. Mount Nero	43	24	0	10	23	0
Vada	43	19	0	10	37	0
Cape Troy	42	49	0	10	44	0
Point Hercole	42	23	10	11	12	0
Civita Vecchia	42	6	0	11	46	0
Rome	41	53	54	12	27	41
Cape d'Anzia	41	24	0	12	37	0
Cercello Point	41	12	0	13	5	0
Gaeta	41	12	0	13	31	0
Naples	40	50	15	14	17	30
Salerno	40	42	0	14	46	0
Policaſtro	40	4	0	15	46	0
Cape Vatican	38	36	0	16	8	0
Cape Scylla	38	14	0	16	3	0
Cape del Arme	37	56	0	15	59	0
Cape Spartevento	37	53	0	16	25	0
Cape Colonne	39	3	0	17	38	0
Cape Lizza	39	18	30	17	32	0
Taranto	40	16	0	17	38	0
Cape St. Mary	39	40	0	18	53	0
Cape Otranto	40	5	0	19	5	0
Brindiſi	40	40	0	18	3	0
Manfredonia	41	39	0	16	17	0
Ortona	42	36	0	14	52	0
Ancona	43	37	54	13	28	52
Comachio	44	25	0	12	3	0
Chiozza	45	15	0	12	4	0
Venice	45	40	0	12	21	0
Trieſte	45	49	0	13	53	0
Rovigno	45	12	0	13	49	0
Segnia	45	11	0	15	19	0
Zara	44	26	30	16	1	30
Sebenico	44	3	0	16	34	30
Narenta	42	52	0	18	3	0
Cape Palli, N. P.	41	21	0	19	44	0
Capa Lenguetta	40	30	0	19	48	0
Butrinto	39	50	0	20	19	0
Cape St. Nicholas	39	34	0	20	30	0
Larta	39	8	0	21	22	0
Coron	36	47	26	21	58	37
Cape Matapan	36	23	20	22	29	15
Cape St. Angelo	36	26	30	23	13	0
Napoli	36	43	30	23	1	0
Corinth	37	53	22	23	2	0
Cape Doro Rock	38	9	59	24	37	4
Salonica	40	39	0	22	45	0
Lagos	40	58	0	25	3	0
Cape Macri	40	35	0	25	37	0
Dardanels	10	10	0	26	18	0
Galipoli	40	25	33	26	38	0
CONSTANTI-NOPLE	41	1	10	28	55	15

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	
Smyrna	38	28	7N.	27	6	33E.
Cape Volpe	36	38	0	27	43	0
Macri	36	32	0	28	31	30
Seven Capes	36	18	0	28	37	0
Cape Chelidoni	36	20	0	30	21	0
Roſa Iſland	36	12	0	29	23	0
Satalia	37	2	30	30	31	0
Cape Dmumonte	36	27	0	32	0	0
Cavelero Point	36	30	0	33	5	0
Cape Urio						
Yaffo	36	44	0	36	4	0
Alexandretta or Scanderoon	36	35	0	36	15	0
Cape Porco	36	14	0	35	48	0
Aleppo	36	11	0	37	10	0
Tripoli	34	46	0	36	7	0
C. Vardo	34	30	30	35	48	0
Cape Serpente	33	36	0	35	37	30
Cape Blanco	33	17	0	35	32	0
St. John D'Acre	33	14	0	35	38	0
Jaffa	32	4	0	35	5	0
Cape Gallo	31	24	0	33	18	0
Damietta	31	31	0	32	0	0
Cape Bourlos	31	43	30	31	16	0
Roſetta	31	22	45	30	43	30
Aboukir	31	19	0	30	25	0
Nelſon's Iſland	31	21	0	30	23	0
Cairo	30	2	21	31	18	30
Alexandria	31	11	20	30	11	15
Cape Roſe	30	59	0	29	25	0
Cape Solomon	31	43	30	25	11	0
C. Razatin	32	28	0	23	15	0
Derne	32	51	0	21	52	0
Cape Raſat	33	1	0	20	27	0
Cape Menſurato	32	7	0	15	11	30
Tripoli	32	54	0	13	18	0
Cape Gergis	33	59	0	11	35	0
Cape Paul	35	11	0	11	9	0
Suza	35	39	0	10	45	0
Cape Bon	37	5	30	11	5	20
Tunis	36	46	0	10	16	0
Cape Blanco	37	27	0	10	7	0
Cape Roſo	37	20	0	9	2	0
Cape Ferro	37	18	0	7	45	0
Cape Bugaroni	37	6	0	7	13	0
Cape Tedels	36	54	0	4	18	0
Cape Cagines	36	47	0	3	12	0
Algiers	36	43	0	3	14	0
Cape Tennis	36	33	0	1	36	0
Cape Ferrat	35	55	0	0	43	0
Cape Falcon	35	46	0	0	46	0
Cape Figalle	35	32	0	1	3	30
Cape Tres Forcas	35	28	0	2	54	0
Cape Negril	35	41	0	5	15	0
Tetuan	35	29	0	5	21	0
Ceuta Point	35	50	0	5	16	9
Tangier	35	48	0	5	49	0
Cape Spartel	35	49	0	5	55	0

South Coaſt of the Mediterranean Sea.

Scutari	41	0	20N.	28	58	0E.
Cape Janiſari	40	2	30	26	4	0
Cape Baba	39	45	0	25	56	0
Adramietta	39	34	0	26	58	0

Iſlands in the Mediterranean.

Alboran	35	56	0N.	3	0	0W
Zaffarina	35	11	0	2	21	0
Fonneterra C. Moſa	38	37	0	1	38	0
Ivica N. E. Point	39	3	0	1	37	0

Table XXVII. Of Latitudes and Longitudes.

Names of Places.	Lat. D. M. S.	Long. D. M.
Ivica S. Point	38 49 0N.	1 25 0E.
Columbretes	39 56 0	0 39 0
Cabrera	39 6 0	3 0 0
Majorca.		
C. Formentor	39 58 0	3 16 0
S. Point, C. Salini	39 14 30	3 8 0
E. Point, C. Pera	39 43 0	3 33 0
Dragonera Isle	39 33 0	2 27 0
Palma	39 32 0	2 42 0
Minorca, C. Bajoli	40 1 0	3 49 0
Port Mahon	39 52 0	4 25 0
Corsica.		
Cape Corse	43 1 30	9 22 0
Saint Fiorenzo	42 35 0	9 19 0
Calvi	42 34 0	8 43 0
Ajaccio	41 50 0	8 42 0
South Point	41 22 0	9 12 0
Tower Diana	42 8 0	9 34 0
Bastia	42 42 0	9 27 0
Sardinia.		
Cape Longo Sardo	41 14 30	9 8 0
Asinari, N.E. Point	41 8 0	8 23 0
Cape Caccia	40 34 0	8 4 45
C. St. Marco	39 52 38	8 26 0
I. S. Pedro, W. P.	39 8 0	8 7 0
C Teulada	38 51 0	8 36 0
Isle Toro (Rock)	38 50 0	8 17 0
Caglaria	39 14 0	9 7 0
C. Carbonera	39 7 0	9 28 0
C. Ferrato	39 23 30	9 42 0
C. Bellavista	40 2 30	9 52 0
C. Comino	40 34 0	9 53 30
I. Biche	41 5 30	9 35 0
Gorgona	43 25 0	9 54 0
Capraria	43 0 0	9 49 0
Elba, West end	42 44 0	10 3 0
Pianoza	42 34 0	10 4 0
Formigues	42 23 30	10 7 0
Monto Christo	42 20 30	10 18 0
Gilio	42 21 0	10 54 0
Ganulo	42 14 0	11 5 0
Palmaria	40 56 0	12 51 0
Ponza, South end	40 54 0	13 0 0
Ischia, South Point	40 40 30	13 55 0
Capri, S.W. Point	40 32 0	14 14 0
Sicily. Messina.		
Cape Orlando	38 8 0	14 53 0
Cape Cefala	38 1 30	14 7 0
Cape Cafrano	38 9 0	14 34 0
Palermo	38 6 45	13 25 30
Cape Gallo	38 12 30	13 24 20
Cape St. Vito	38 12 0	12 54 0
Trapano	38 2 0	12 42 0
C. 3 Fontani	37 35 0	12 47 30
Cape Alicante	37 3 0	14 0 0
Cape Saramis	36 47 0	14 36 0
Cape Passaro	36 40 0	15 17 0
Siracusa	37 7 0	15 22 0
Cape Moline	37 36 0	15 19 0
Stromboli	38 48 0	15 28 0
Lipari, South Point	38 31 0	15 11 0
Salina, East Point	39 19 0	15 9 0
Felicuri,	38 40 0	14 42 0

Names of Places.	Lat. D. M. S.	Long. D. M.
Alicudi	38 41 0N.	14 23 0E.
Ustria, West Point	38 47 0	13 17 0
El Navio	38 47 30	14 48 10
Levanso	38 3 0	12 29 0
Maritimo	38 2 0	12 21 20
Favouillane	38 0 0	12 30 0
Galiti, East Point	37 48 0	9 18 0
Esquerques	37 47 0	10 58 50
Pantellaria, N. Point	36 54 50	12 11 0
Linosa, N. Point	35 56 0	13 3 30
Lampidosa, N. Point	35 40 30	12 49 0
Goza, N.W. Point	36 5 0	14 7 0
Malta, C. Comoneto	36 1 30	14 18 0
La Valetta	35 53 30	14 30 30
P. Marza Sirocco	35 5 0	14 34 0
Gulf of Venice.		
Fano	40 2 0	20 40 0
Pelegosa	42 23 0	16 32 0
Plana	42 13 0	16 0 0
Tremite	42 13 0	15 43 0
Lissa, South Point	42 55 0	16 30 0
Pomo	43 10 0	15 43 30
Longa, S. E. Point	44 10 40	15 34 30
Coronate, N. W. P.	44 10 0	15 37 0
Sansego, S. Point	44 36 0	14 30 20
Brazza, N. W. Point	43 20 0	16 56 0
Palermo, I. Lusina	43 12 30	16 51 0W
Curzula, W. Point	42 47 0	17 0 0
Agusta, N. Point	42 35 0	17 4 0
Melida, W. Point	42 31 0	17 40 0
Cephalonia, S. Point	37 55 0	21 17 0
— Cape Viscardo	38 24 0	21 3 20
Corfu Point, Timon	39 38 0	19 58 0
Paxu, N. W Point	39 18 0	20 23 0
Zante, S. Point	37 32 30	21 11 0
Archipelago.		
Pt. Timone, I. Corfu	39 38 0	19 58 0E.
Paxo, N.W. Point	39 18 0	20 23 0
Cefalonia, S. Point	37 55 0	21 17 0
— Cape Fiscardo	38 24 0	21 3 0
Zante, South Point	37 33 0	21 12 0
Cerigo, South Point.	36 8 0	22 57 0
Cerigotto	35 49 0	23 17 0
Milo Mown	36 41 42	24 22 12
Scio, Town	38 17 0	26 6 0
Mytelene Town	39 10 0	26 26 0
Tenedos	39 43 0	25 52 0
Lemnos, N.E. P.	40 0 0	25 26 0
Candia.		
Cape Crio	35 10 0	23 25 0
Cape Spada	35 41 0	23 40 0
Suda	35 23 0	24 5 0
Cape Susa	35 28 0	25 7 0
Candia	35 18 40	25 18 0
Cape Sidera	35 10 0	26 17 0
Cape Salamone	35 1 11	26 26 0
—		
Goze, South Point,	34 50 0	23 50 0
Panto, N.E. P.	35 49 10	26 58 0
Rhodes, Town	36 27 0	28 30 0
— Cape Tranquillo	36 5 0	27 30 0
Cyprus.		
Cape Andrew	35 41 0	34 28 0

ames of Places.	Lat. D.	M.	S.	Long. D.	M.	S.
ina	35	14	0N.	32	48	0E.
e Salizano	35	0	0	31	41	0
e de Gatt	34	34	0	33	5	0
e Grego	35	7	20	34	2	0

Coast of Africa, from Cape Spartel to the Cape of Good Hope.

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	S.
Cape Spartel	35	49	0N.	5	55	0W
Larash	35	12	0	6	6	0
New Sale, or Rabat	34	3	0	6	47	0
Mazagan	33	18	30	8	25	0
C. Blancho	33	10	0	8	38	0
C. Cantin	32	34	0	9	5	0
Saffia, or Aziffia	32	20	0	9	2	0
Mogadore Island	31	27	0	9	36	0
Cape Geer	30	38	0	9	52	0
Santa Cruz	30	27	30	9	40	0
Cape Nun	28	40	0	11	15	0
Cape Blanca	27	57	0	12	54	0
Cape Bajador	26	14	0	14	31	0
Horn Island, Entrance of Rio do Ouro	23	35	30	15	18	0
Cape das Barbas	22	15	30	16	39	45
Isle de Lobo	21	7	10	17	15	0
Cape Blanco	20	55	30	17	29	55
Cape St. Ann	20	42	30	16	35	0
Cape Myrick	19	12	30	16	21	0
Portendick	18	6	20	16	4	0
Barbary Point, Entrance of Senegal B.	51	53	0	16	31	15
Cape Verd	14	46	0	17	51	0
Breakers, off Ditto	14	50	30	17	58	0
Goree Island	14	40	50	17	40	0
Cape Naze	14	24	0	17	18	0
Cape St. Mary, Entrance to the River Gambia	3	17	0	16	56	0
Cape Roxo	12	23	0	17	10	0
Cape Vergu	9	52	0	14	56	0
Delos Isles	9	29	0	14	7	0
C. Sierra Leon	8	29	30	13	48	0
Cape Anne	7	7	0	13	27	0
Cape Mount	6	46	0	11	42	0
Cape Monserado	6	16	0	11	17	0
Cape Baxos	5	28	0	10	7	0
Seftos River	5	27	0	9	47	0
Cape Formosa	5	8	0	9	39	0
Cape Palma	4	26	0	8	15	0
St. Andrew's River	4	58	0	6	30	0
Cape Maho	5	12	0	5	12	0
Cape Appolonia	4	59	0	3	11	0
Axim	4	52	0	2	36	0
C. Three Points	4	40	0	2	38	0
Dix Cove	4	48	0	2	22	0
Sakondee	5	0	0	1	59	0
Elmina	5	10	0	1	40	0
Cape Corse Castle	5	12	0	1	48	0
Devil's Hill	5	24	0	0	50	0E
Annamaboe Fort	5	10	0	1	7	0
Acra	5	30	0	0	16	0
Barracoa	5	53	0	1	29	0

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	S.
River Volta	5	53	0N.	1	25	0E.
Cape St. Paul	5	52	0	1	40	0
Whidah	6	25	0	3	13	0
Formosa River	5	53	0	6	10	0
C. Formosa	4	30	0	6	40	0
New Callabar River	4	23	0	8	0	0
Cameron River	3	20	0	10	0	0
Cape St. John	1	15	0	9	23	0
Gabon River	0	0	0	9	23	0
C. de Lopez Gonsalvez	0	47	0S.	9	12	0
Sesto River	2	16	0	9	35	0
Alvary Bay	3	27	0	10	40	0
Congo River	4	35	0	11	5	0
Ambris River	6	45	0	12	0	0
Cape Ledo	9	50	0	12	3	0
S. Philip de Benguela	12	18	0	12	35	0
Cape Negro	16	0	0	11	44	0
Tigers Island	16	30	0	12	0	0
Cape Frio	18	40	0	13	42	0
C. Rostro de Pedro	23	0	0	14	0	0
Angra Pequena	26	35	0	15	40	0
Cape das Voltas	29	0	0	16	45	0
St. Helen's Bay Cape St. Martin's	32	45	0	17	45	0
Saldannah Bay	33	8	0	18	0	0
Cape of Good Hope	34	29	0	18	23	0

Islands, Rocks, and Shoals, in the North Atlantic Ocean, and South Atlantic, or Southern Ocean.

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	S.
Rockal	57	13	0N.	14	18	0W
Atkins Shoal	55	6	0	11	32	0
Chapel Rock, D.	47	34	0	7	12	0
—Rock, D.	46	25	0	13	12	0
— Rock	36	30	0	23	10	0
Steen Ground	32	45	0	21	25	0
Josyna Rock	30	46	0	24	41	0
Bermudas Isle	32	35	0	63	28	0
Breakers	32	35	0	67	45	0
Azores, or Western Islands.						
Corve, South Point	39	41	13	31	7	30
Flores, Pt. Delgada	39	33	29	31	7	0
Fayal, S. E. Point	34	30	12	28	41	36
Pico, Sumenes	38	27	0	28	28	0
— Point de Espertal	38	26	0	28	36	30
— East Point	38	22	0	28	6	0
St. George, S.E. Point	38	30	45	27	50	0
Graciosa						
— Villa da Praya	39	2	30	27	59	0
Terceira, Angra	38	38	10	27	13	34
St. Michael						
— Pta. Delgada	37	44	0	25	44	30
— Pta. Ferraria	37	54	15	25	58	18
— North East Point	37	52	30	25	14	30
Formigas, or Ants	37	17	10	24	54	0
St. Mary, Town	36	57	40	25	13	0
— West Point	36	58	45	25	16	0
— Punta da Castello	36	57	0	25	6	0
Madeira Isles.						
Porto Santo, Town	32	58	15	16	25	0

Table XXVII. Of Latitudes and Longitudes.

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	S.
Augusta Shoal	33	44	oS	36	16	oE.
Dutch Bank ...	37	20	0	38	52	0
Pr. Edward's Isles,						
— North end	46	39	30	38	2	30
— South end	46	52	30	37	47	0
Kergulen's Land						
Bligh's Cape ..	48	29	0	68	38	15
— Christmas Harb.	48	41	15	69	2	0
— Cape Digby	49	23	30	70	32	0
— Cape George....	49	54	30	70	12	0
— Port Pallifer ..	49	3	15	69	35	0
Amsterdam I. ...	37	51	0	77	44	0
St. Paul	38	44	0	77	18	0
Cloates I.	21	45	0	93	27	0
Tryal Rocks	20	40	0	104	30	0
Christmas Island ...	10	35	0	104	49	0
Keeling's Islands...	12	3	15	97	38	30
Madagascar Island.						
Cape St. Mary ...	25	33	0	44	55	0
St. Augustin's Bay..	23	35	0	43	30	0
Cape St. Vincent...	21	46	0	43	37	0
Cape St. Andrew's	16	6	0	45	32	0
Cape St. Sebastian..	12	30	0	49	44	0
C. Ambro or Natal .	12	2	0	50	19	0
Antongil Bay, entr.	16	0	0	50	38	0
St. Mary's Island ..	16	54	0	50	36	0
Juan de Nova ...	17	15	0	43	7	0
Foul Point	17	41	0	49	59	0
Port Dauphin ..	25	0	0	47	5	0
Mozambique Passage.						
Bassas de India	22	20	0	41	30	0
Europa Rocks ...	21	30	0	40	17	0
Suffex Rocks	21	29	0	42	26	0
Bazaruto Rocks....	21	16	0	36	30	0
English Bank ..	17	30	0	39	27	0
St. Christopher's I.	17	10	0	43	50	0
Coffin Island ...	17	28	0	44	7	0
Chesterfield Shoal ..	16	17	0	44	0	0
Comoro Isles.						
Mayotta	12	47	0	45	30	0
Johanna I. ..	12	15	0	44	35	0
Mohilla	12	30	0	43	55	0
Comoro	11	32	0	43	30	0
—						
John Martin's I. ...	10	9	0	43	15	0
Portuguese Shoals ..	12	33	0	46	55	0
Aldabra Islands	9	40	0	46	45	0
Assumption ...	9	46	0	47	37	0
Cosmoledo Islands ..	9	46	0	48	38	0
Sandy Islands	9	16	0	48	12	0
Natal Island ...	8	30	0	47	15	0
St. Peter's Island...	9	34	0	50	47	0
John de Nova ...	10	15	0	53	30	0
Providence Island ..	9	15	0	53	32	0
Zanzibar I S. end	6	10	0	40	45	0
AmiranteI.N W.Pt.	5	10	0	53	45	0
— S. E. part ..	6	30	0	55	0	0
St Frances Isles,	7	10	0	56	30	0
Mahé Bank						
— N. W. part	3	50	0	54	5	0
— S. E. part ...	5	20	0	56	30	0
Curreuse I.	4	19	0	55	47	0

Names of Places.	Long. D.	M.	S.	Long. D.	M.	S.
Eagle I.	5	10	oS.	55	37	o
Seychelle I.	4	35	0	55	35	0
Sandy Island ...	15	10	0	55	5	0
Nazareth Bank,						
— N. E. part	13	35	0	61	44	0
— S. W. part ...	16	45	0	60	0	0
St. Brandon ..	16	34	0	62	50	0
Roderigos	19	40	0	63	10	0
Port Louis ...	20	9	44	57	28	15
L'Isle Mauritius ...	20	10	0	57	35	0
Bourbon,						
— St. Dennis	20	51	43	55	30	0
South Roquepiz ...	10	30	0	64	32	0
Speaker's Bank	4	45	0	72	57	0
Peros Banhos	5	30	0	72	20	0
Boddam's I. ...	5	22	0	72	15	0
Diego Garcia	7	30	0	72	35	0
Candu Islands	6	0	0	76	35	0
Adu Islands	5	30	0	76	20	0
Maldive I. S. E. part	0	40	oS.	74	55	0
— N. W. part	7	15	oN.	73	40	0
Maldive Islands ...	8	15	0	73	29	0
Laccadive Isles,						
— N. W. part ...	12	36	0	72	25	0
— S. E. part	10	0	0	72	45	0
Ceylon Island.						
— North Point ...	9	57	0	80	39	0
Point de Galle ..	6	1	0	80	19	26
— South Point ...	5	47	0	81	2	0
Grand Bassas ..	6	7	30	81	42	50
Elephant Point	6	20	0	81	39	15
Trincomaley ..	8	35	0	81	27	0
Bale of Cotton Rock	5	28	0	86	15	0
—						
Preparis Island	14	50	0	93	35	0
Cocos Islands,						
— Great ...	14	5	0	93	14	0
— Little ...	13	58	0	93	7	0
Andaman Islands.						
Great Andaman,						
— North Point	13	30	0	92	30	0
— South Point	11	21	0	92	35	0
— Port Cornwallis..	13	20	30	92	51	0
Little Andaman,						
— South Point ..	10	40	0	92	24	0
—						
Barren Island ..	12	14	0	93	42	0
Narcondam Island ..	13	25	15	94	7	0
Nicobar Isles.						
— North Piont ..	9	25	0	93	7	0
— South Point ..	6	51	0	94	17	0
Miroe Island	7	29	0	93	37	39
Nicobar,orGreatSambelong, S. end ..	7	10	0	93	40	0
—						
Pulo Seyer	7	35	0	95	30	0

Rocks, and Shoals, between the
ı and Pacific Oceans, from Su-
to New Guinea.

f Places.	Lat. D. M. S.	Long. D. M. S.
ıtra.		
'oint	3 11 2cS.	106 18 40E.
....	3 49 9	102 2 25
d ...	5 22 0	95 26 0
Malacca		
capore.		
E. P. ..	5 42 0	95 33 0
), Ronde	0 5 59N.	95 13 0
, E. Point	5 32 0	95 11 0
....	3 15 0	95 52 0
S. Point	2 30 0	95 45 0
....	0 57 0	97 2 0
n, S. Pt.	0 25 0S.	97 45 0
ne Isles,		
ıint ...	1 57 0	99 49 0
South P.	3 15 0	100 25 0
and	5 20 0	101 54 0
....	5 46 0	99 8 30
,orPrince		
's Island	5 27 0	100 25 0
....	3 57 0	100 17 0
ina Sea.		
entrance		
traits of		
...	0 18 0 S	105 15 0
a	1 18 0N.	104 31 49
....	2 28 0	103 30 0
I. ...	2 30 0	105 52 0
....	2 40 0	104 43 0
, S. Pt.	2 49 0	104 24 0
Isles.		
...	2 47 0	105 21 0
ıbas	2 47 0	106 15 0
d	2 17 0	105 44 0
rWood I.	1 34 0	105 47 0
......	8 40 0	105 45 0
hina Sea.		
.....	4 5 0	108 10 0
Island..	0 45 0	106 38 0
Island..	1 0 0	107 15 0
....	0 7 0	106 30 0
E. Pt...	3 6 0S.	108 15 0
d ...	2 25 0	107 7 45
land.		
nt, N.P.	1 33 0	106 0 0
ll ..	2 1 20	105 21 7
...	3 4 0	106 17 0
-		
and ...	3 10 45	106 17 30
slands..	1 5 16	105 24 4
.		
...	6 36 25	105 15 15
....	6 6 0	105 31 40
Sunda.		
...	6 6 0	105 36 0

Names of Places.	Lat. D. M. S.	Long. D. M. S.
Peck-on, Tamarind Island	6 54 0N.	105 18 0E.
North Island ...	5 37 5	105 55 0
Pulo Babee, E. ent.	5 45 0	106 20 30
Java Sea,		
The Brothers	5 1 20	106 14 0
Jason's Rock ..	5 30 0	106 21 0
Pulo Rachel ...	5 53 0	108 3 0
Carimon Java, E. most	5 48 0	109 25 0
Lubec Island ...	5 43 0	111 41 0
Great Salombo ...	5 28 0	113 18 0
I. Salombo, S. most	5 33 0	113 13 0
Bratteron Shoals ...	5 30 0	113 41 0
Java Island.		
Java Head, W. Pt.	6 48 0	105 5 0
Anjer Point ...	6 3 17S.	106 1 57
Bantam Point	5 50 20	106 9 3
Batavia	6 11 0	106 50 0
Indermay Point ...	6 13 0	109 4 0
Cape Sandana ...	7 39 0	114 36 0
East Point	8 39 0	114 40 0
Wessels Bay ...	8 28 0	112 38 0
Turtle Bay	8 0 0	109 37 0
Winerow Point ..	7 25 0	106 5 0
Eastern Str. to China.		
Bally I. S. Point ..	8 56 0	115 23 0
Bally Str. S. ent. ...	8 45 0	114 47 0
Lombock Straits .	9 10 0	115 57 0
Straits of Mass ...	9 0 0	116 50 0
Little Paternosters,		
— Southernmost ...	2 13 0	117 12 0
— Northernmost ...	2 15 0	117 12 0
Tonekaky	5 31 0	117 17 0
Straits of Sapy	8 30 0	119 32 0
Sandelwood Island ..	9 45 0	120 0 0
Rotto Id. S. end ...	11 15 0	123 7 0
Banda Sea.		
Timor I. W. Point	10 15 0	123 43 0
— S. Point	10 23 0	123 58 0
Timor Laoot, S. Pt.	8 15 0	131 50 0
Timorland, S. Point	8 3 0	132 17 0
Amboyna	4 25 0N.	127 25 0
Gillolo, N. end	2 17 0	127 20 0
— West end ...	1 8 0	127 1 0
Heri Island	0 59 0	126 54 0
Ternate Island	0 57 0	126 53 0
Celebes, N. Point ..	2 0 0	124 0 0
— South Point ...	5 42 0	120 6 0
Mareane Island	0 21 0	126 40 0
Sutta Mangle Island	1 48 0	126 17 0
Sutta Bassia ...	2 36 0	125 41 0
Burro Island, W. Pt.	3 3 0	125 43 0
Cambona Island ..	5 29 0	121 26 0
Donthin Hill ..	5 30 0	117 53 0
Macassar Town	5 11 0	117 28 0
Tonyn Island	5 27 0	118 2 0
Straits of Macassar.		
Bouton I. S. Point .	5 42 0	121 11 0
N. E. end of a Shoal off Bouton Island.	5 25 0	122 8 0
Tocca Bassia Island..	5 35 0	123 15 0
Saleyer Straits ...	5 44 0	120 6 0

TABLE XXVII. OF LATITUDES AND LONGITUDES.

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	S.
Augusta Shoal	33	44	cS	36	16	oE.
Dutch Bank	37	20	0	38	52	0
Pr. Edward's Isles,						
— North end	46	39	30	38	2	30
— South end	46	52	30	37	47	0
Kerguelen's Land						
Bligh's Cape	48	29	0	68	38	15
— Christmas Harb.	48	41	15	69	2	0
— Cape Digby	49	23	30	70	32	0
— Cape George	49	54	30	70	12	0
— Port Pallifer	49	3	15	69	35	0
Amsterdam I.	37	51	0	77	44	0
St. Paul	38	44	0	77	18	0
Cloates I.	21	45	0	93	27	0
Tryal Rocks	20	40	0	104	30	0
Christmas Island	10	35	0	104	49	0
Keeling's Islands	12	3	15	97	38	30
Madagascar Island.						
Cape St. Mary	25	33	0	44	55	0
St. Augustin's Bay	23	35	0	43	30	0
Cape St. Vincent	21	46	0	43	37	0
Cape St. Andrew's	16	6	0	45	32	0
Cape St. Sebastian	12	30	0	49	44	0
C. Ambro or Natal	12	2	0	50	19	0
Antongil Bay, entr.	16	0	0	50	38	0
St. Mary's Island	16	54	0	50	36	0
Juan de Nova	17	15	0	43	7	0
Foul Point	17	41	0	49	59	0
Port Dauphin	25	0	0	47	5	0
Mozambique Passage.						
Bassas de India	22	20	0	41	30	0
Europa Rocks	21	30	0	40	17	0
Sussex Rocks	21	29	0	42	26	0
Bazaruto Rocks	21	16	0	36	30	0
English Bank	17	30	0	39	27	0
St. Christopher's I.	17	10	0	43	50	0
Coffin Island	17	28	0	44	7	0
Chesterfield Shoal	16	17	0	44	0	0
Comoro Isles.						
Mayotta	12	47	0	45	30	0
Johanna I.	12	15	0	44	35	0
Mohilla	12	30	0	43	55	0
Comoro	11	32	0	43	30	0
——						
John Martin's I.	10	9	0	43	15	0
Portuguese Shoals	12	33	0	46	55	0
Aldabra Islands	9	40	0	46	45	0
Assumption	9	46	0	47	37	0
Cosmoledo Islands	9	46	0	48	38	0
Sandy Islands	9	16	0	48	12	0
Natal Island	8	30	0	47	15	0
St. Peter's Island	9	34	0	50	47	0
John de Nova	10	15	0	53	30	0
Providence Island	9	15	0	53	32	0
Zanzibar I. S. end	6	10	0	40	45	0
Amirante I. N W Pt.	5	10	0	53	45	0
— S. E. part	6	30	0	55	0	0
St Frances Isles,	7	10	0	56	30	0
Mahé Bank						
— N. W. part	3	50	0	54	5	0
— S. E. part	5	20	0	56	30	0
Curreuse I.	4	19	0	55	47	0

Names of Places.	Long. D.	M.	S.	Long. D.	M.	S.
Eagle I.	5	10	cS.	55	37	oE.
Seychelle I.	4	35	0	55	35	0
Sandy Island	15	10	0	55	5	0
Nazareth Bank,						
— N. E. part	13	35	0	61	44	0
— S. W. part	16	45	0	60	0	0
St. Brandon	16	34	0	62	50	0
Roderigos	19	40	0	63	10	0
Port Louis	20	9	44	57	28	15
L'Isle Mauritius	20	10	0	57	35	0
Bourbon,						
— St. Dennis	20	51	43	55	30	0
South Roquepiz	10	30	0	64	32	0
Speaker's Bank	4	45	0	72	57	0
Peros Banhos	5	30	0	72	20	0
Boddam's I.	5	22	0	72	15	0
Diego Garcia	7	30	0	72	35	0
Candu Islands	6	0	0	76	35	0
Adu Islands	5	30	0	76	20	0
Maldive I. S. E. part	0	40	cS.	74	55	0
— N. W. part	7	15	cN.	73	40	0
Maldive Islands	8	15	0	73	29	0
Laccadive Isles,						
— N. W. part	12	36	0	72	25	0
— S. E. part	10	0	0	72	45	0
Ceylon Island.						
— North Point	9	57	0	80	39	0
Point de Galle	6	1	0	80	19	26
— South Point	5	47	0	81	2	0
Grand Bassas	6	7	30	81	42	50
Elephant Point	6	20	0	81	39	15
Trincomaley	8	35	0	81	27	0
Bale of Cotton Rock	5	28	0	86	15	0
——						
Preparis Island	14	50	0	93	35	0
Cocos Islands,						
— Great	14	5	0	93	14	0
— Little	13	58	0	93	7	0
Andaman Islands.						
Great Andaman,						
— North Point	13	30	0	92	30	0
— South Point	11	21	0	92	35	0
— Port Cornwallis	13	20	30	92	51	0
Little Andaman,						
— South Point	10	40	0	92	24	0
——						
Barren Island	12	14	0	93	42	0
Narcondam Island	13	25	15	94	7	0
Nicobar Isles.						
— North Piont	9	25	0	93	7	0
— South Point	6	51	0	94	17	0
Miroe Island	7	29	0	93	37	30
Nicobar, or Great Sambelong, S. end	7	10	0	93	40	0
——						
Pulo Seyer	7	35	0	95	30	0

Islands, Rocks, and Shoals, between the Indian and Pacific Oceans, from Sumatra to New Guinea.

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	S.
Sumatra.						
Lucepara Point	3	11	20S.	106	18	40E.
Bencoolen	3	49	9	102	2	25
Achen Head ...	5	22	0	95	26	0
Straits of Malacca and Sincapore.						
Pulo Way, E. P. ..	5	42	0	95	33	0
Pulo Rondo, Ronde	0	5	59N.	95	13	0
Pulo Brasse, E. Point	5	32	0	95	11	0
Cocos Isles	3	15	0	95	52	0
Hog Island, S. Point	2	30	0	95	45	0
Pulo Nias	0	57	0	97	2	0
Pulo Minton, S. Pt.	0	25	0S.	97	45	0
Good Fortune Isles,						
— South Point ...	1	57	0	99	49	0
Nassau Id. South P.	3	15	0	100	25	0
Enganno Island	5	20	0	101	54	0
Pulo Pera	5	46	0	99	8	30
PuloPenang,orPrince of Wales's Island .	5	27	0	100	25	0
Pulo Jarra	3	57	0	100	17	0
Ent. of China Sea.						
Bintang, E. entrance to the Straits of Sincapore ..	0	18	0S	105	15	0
Pedra Branca	1	18	0N.	104	31	49
Pulo Aroe	2	28	0	103	30	0
Pulo Tinoy I. ...	2	30	0	105	52	0
Pulo Aor	2	40	0	104	43	0
Pulo Timon, S. Pt.	2	49	0	104	24	0
Anambas Isles.						
Pulo Domar ...	2	47	0	105	21	0
South Anambas	2	47	0	106	15	0
Saddle Island	2	17	0	105	44	0
Victory's, orWood I.	1	34	0	105	47	0
Condor	8	40	0	105	45	0
Ent. of the China Sea.						
Natuna I.	4	5	0	108	10	0
St. Julian's Island..	0	45	0	106	38	0
Timbelan's Island ..	1	0	0	107	15	0
Sprit I.	0	7	0	106	30	0
Billiton, S. E. Pt...	3	6	0S.	108	15	0
Gaspar Island ...	2	25	0	107	7	45
Banca Island.						
Point Pleasant, N.P.	1	33	0	106	0	0
Monopin Hill ..	2	1	20	105	21	7
East Point ...	3	4	0	106	17	0
Lucepara Island ...	3	10	45	106	17	30
The Seven Islands..	1	5	16	105	24	4
Princes' I. ...	6	36	25	105	15	15
Oracaloe I.	6	6	0	105	31	40
Straits of Sunda.						
Caracatoa ...	6	6	0	105	36	0

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	S.
Peck-on, Tamarind Island	6	54	0N.	105	18	0E.
North Island ..	5	37	5	105	55	0
Pulo Babee, E. ent.	5	45	0	106	20	30
Java Sea,						
The Brothers	5	1	20	106	14	0
Jason's Rock ..	5	30	0	106	21	0
Pulo Rachel ...	5	53	0	108	3	0
Carimon Java,E.most	5	48	0	109	25	0
Lubec Island	5	43	0	111	41	0
Great Salombo ...	5	28	0	113	18	0
I. Salombo, S. most	5	33	0	113	13	0
Bratteron Shoals ...	5	30	0	113	41	0
Java Island.						
Java Head, W. Pt.	6	48	0	105	5	0
Anjer Point ...	6	3	17S.	106	1	57
Bantam Point	5	50	20	106	9	3
Batavia	6	11	0	106	50	0
Indermay Point ...	6	13	0	109	4	0
Cape Sandana ...	7	39	0	114	36	0
East Point	8	39	0	114	40	0
Wessels Bay ...	8	28	0	112	38	0
Turtle Bay	8	0	0	109	37	0
Winerow Point ..	7	25	0	106	5	0
Eastern Str. to China.						
Bally I. S. Point ..	8	56	0	115	23	0
Bally Str. S. ent. ...	8	45	0	114	47	0
Lombock Straits .	9	10	0	115	57	0
Straits of Mass ...	9	0	0	116	50	0
Little Paternosters,						
— Southernmost...	2	13	0	117	12	0
— Northernmost...	2	15	0	117	12	0
Tonekaky	5	31	0	117	17	0
Straits of Sapy	8	30	0	119	32	0
Sandelwood Island ..	9	45	0	120	0	0
Rotto Id. S. end ...	11	15	0	123	7	0
Banda Sea.						
Timor I. W. Point	10	15	0	123	43	0
— S. Point	10	23	0	123	58	0
Timor Laoot, S. Pt.	8	15	0	131	50	0
Timorland, S. Point	8	3	0	132	17	0
Amboyna	4	25	0N.	127	25	0
Gillolo, N. end	2	17	0	127	20	0
— West end ...	1	8	0	127	1	0
Heri Island	0	59	0	126	54	0
Ternate Island	0	57	0	126	53	0
Celebes, N. Point ..	2	0	0	124	0	0
— South Point ...	5	42	0	120	6	0
Mareane Island	0	21	0	126	40	0
Sutta Mangle Island	1	48	0	126	17	0
Sutta Bassia ...	2	36	0	125	41	0
Burro Island, W. Pt.	3	3	0	125	43	0
Cambona Island ..	5	29	0	121	26	0
Donthin Hill ..	5	30	0	117	33	0
Macassar Town	5	11	0	117	28	0
Tonyn Island	5	27	0	118	2	0
Straits of Macassar.						
Bouton I. S. Point .	5	42	0	121	11	0
N. E. end of a Shoal off Bouton Island.	5	25	0	122	8	0
Tocca Bassia Island..	5	35	0	123	15	0
Saleyer Straits ...	5	44	0	120	6	0

Table XXVII. Of Latitudes and Longitudes.

Names of Places.	Lat. D. M. S.	Long. D. M. S.
Borneo Ifland.		
North Point	7 0 0N.	116 45 0E.
Unafang Point, E.P.	5 15 0	118 50 0
Point Salatan, S.E.P.	4 15 0S.	114 25 0
PointSambar, S.W.P.	2 45 0	109 28 0
Banguey	7 17 0	117 30 0
Balambangan I.	7 30 0N.	117 2 0
Palawan, S. Point	8 28 0	117 30 0
— North Point	11 20 0	119 46 0
Sooloo, E. Point	5 57 0	121 21 0
Sooloo I. S. Point	5 57 0	121 15 30
— Temontanges	5 57 0	120 53 30
Philippine Iflands.		
Mindanao		
— Pt. St Auguftine	6 15 0	127 20 0
- Mindanao, S. Pt.	5 34 0	126 5 0
Goat Ifland	13 55 0	120 2 0
Luconia, N. Point.	18 45 0	120 45 0
— Manilla	14 36 8	120 51 15

Iflands, Rocks, and Shoals, in the China Sea.

Names of Places.	Lat. D. M. S.	Long. D. M. S.
Pulo Brata	4 45 0N.	103 30 0E.
Ridang I.	6 20 0	102 37 0
Pulo Coron	7 17 0	102 30 0
Pulo Way	10 0 0	102 34 0
Pulo Uby	8 30 0	103 45 0
Two Brothers	8 32 0	105 37 0
Pulo Condor	8 40 0	106 31 37
Pulo Sapata	10 4 30	109 13 0
Elephant I.	10 4 0	108 42 0
Pitt's I.	10 55 0	114 35 0
Sandy I.	10 40 0	112 48 0
Smallkey	10 37 0	112 44 0
Long I.	10 20 0	112 36 0
New I.	10 10 0	112 20 0
Firft Shoal	10 14 0	112 24 0
Second Shoal	10 4 0	112 15 0
Third Shoal	10 5 0	112 10 0
Reef	10 15 0	112 0 0
Scarborough Rocks	15 0 0	117 12 0
Macclesfield Shoal,		
—North Point	16 6 0	114 10 0
— South Point	15 15 0	114 20 0
Triangles, N. Point	17 0 0	111 0 0
— South Point	16 0 0	111 32 0
Pratas Rock, N. fide	20 57 30	116 57 30
— S. W. fide	20 42 0	116 40 0
Paracel's, N. part	16 30 0	110 0 0
— South part	11 37 0	109 30 0
Hainan, N. Point	20 2 0	110 15 0
— South Point	18 12 0	109 20 0

The Coaft and adjacent Iflands from Canton to Cape North.

Names of Places.	Lat. D. M. S.	Long. D. M. S.
Canton	23 6 57N.	113 16 7E.
Macao	22 13 0	113 52 0
Grand Ladrone	22 2 0	113 56 0
Southernmoft	8 0 0N.	114 6 0E.
Ningpo	29 57 45	120 18 0
Pekin	39 54 47	116 24 51
Cape Lopatka	51 0 15	156 42 30
Cape Gavareea	51 20 0	158 36 0
St. Peter & St. Paul	52 51 45	158 46 30
Kronotfkos Nofs	54 43 0	162 13 30
Kamfchatka Nofs	56 1 3	163 18 30
Thadeus Nofs	62 50 0	179 5 0
Cape Ifchukotfkoi	64 14 30	173 31 0
Eaft Cape	66 5 30	169 9 30
Sarda Kamen	67 3 0	171 54 30W.
Cape North	68 56 0	179 11 30
Grafton Ifland	20 4 0	120 0 0E.
Formofa I. S. end	22 5 0	120 50 0
— Tayoan	22 40 0	120 20 0
— North end	25 15 0	122 13 0
Great Lequeo, S. P.	25 15 0	128 30 0
— North Point	28 0 0	128 30 0
Xuno I. S. Point	31 30 0	131 50 0
— North Point	34 45 0	131 30 0
Niphon I. South end	33 30 0	135 0 0
— North end	41 0 0	142 0 0
Matoofmaee	42 30 0	140 30 0
Mednos Ifland	54 27 0	167 55 45
Beerings Ifland	55 36 0	167 46 0
St. Lawrence Ifland	63 47 0	171 45 0

The Coaft of New Holland and adjacent Iflands.

Names of Places.	Lat. D. M. S.	Long. D. M. S.
Swilley Ifland	43 55 0S.	147 7 30E.
South Cape	43 42 0	146 58 0
South Weft Cape	43 37 30	146 5 30
Mew Stone	43 47 15	146 26 30
Tafman's Head	43 33 30	147 33 30
Adventure Bay	43 21 20	147 31 40
Cape Howe	37 31 15	145 31 0
Point Dromedary	36 18 0	150 5 0
Cape St. George	35 19 0	150 18 0
Red Point	34 29 0	151 15 0
Botany Bay	34 6 0	151 23 0
Port Jackfon	33 50 0	151 25 0
Port Stephens	32 40 0	152 9 0
Cape Hawke	32 14 0	152 30 0
Smoaky Cape (near)	30 31 0	153 6 0
Cape Byron	27 27 30	153 30 0
Point Danger	28 8 22	153 33 10
Indian Head	25 3 0	
Cape Moreton	26 56 0	153 32 0
Buftard Bay	24 4 0	151 44 0
Sandy Point	24 45 0	153 9 0
Cape Capricorn	23 29 0	151 2 0
Cape Townfhend	22 15 0	150 17 0
Trinity Sound	22 10 0	149 42 0
Cape Palmerfton	21 30 0	149 6 0
Cape Conway	20 36 0	148 32 0
Cape Gloucefter	19 59 0	148 11 0
Cape Upftart	19 36 0	147 28 0
Cape Sandwich	18 17 11	146 1 13

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	S.
Cape Grafton	16	57	0S.	145	54	0E
Cape Tribulation...	16	6	0	145	21	0
Endeavor River....	15	26	0	145	14	41
Cape Bedford	15	16	0	145	15	0
Cape Flattery	14	56	0	145	17	0
Cape Weymouth...	12	42	0	142	45	0
Cape Granville	11	58	0	142	22	0
York Cape	10	37	0	141	36	0
Cape Cornwall	10	43	0	141	0	0
Endeavor Straits ...	10	39	0	141	24	0

Islands and Rocks, &c. in the Pacific Ocean.

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	S.
Sled e Island ..	64	30	0N.	166	8	0E.
Clerk's Island ...	61	15	0	169	40	0W
Ander o 's Island ..	60	17	0	162	31	0
Gore's I. C. Upright	60	22	0	172	26	0
Key's I. S. W. end	59	48	0	143	8	30
Round Island	58	56	30	153	30	0
S. Hermogenes Isl.	58	15	0	152	13	0
Trinity Island ...	56	35	0	154	53	0
Foggy Island	56	12	0	157	19	30
Oonemak Island....	54	30	30	167	31	0
Cooper's I. S. Pt. ..	54	24	0	169	0	0
Oonalaska	53	54	45	166	26	0
Sulphur Island ...	24	48	0	141	20	0
North Island ..	25	14	0	141	14	0
South Island ...	24	22	30	141	24	0
Tinian	14	58	0	145	5	0
St. Andrew's Island.	5	18	0	133	40	0
Dangerous Shoal ..	2	53	0	136	10	0
Freewill, or St. David's Islands.....	0	50	0	137	51	0
Pelew Islands	7	19	0	134	40	0
Piscadores, N. end .	11	20	0	165	44	0
— South end	11	0	0	166	45	0
Oeyhee, N. Point..	20	17	0	155	59	0
— South Point ...	18	54	30	155	48	0
— East Point	19	33	0	154	52	0
Mowee, E. Point...	20	50	30	155	55	0
— South Point ..	20	34	30	156	12	30
— West Point ...	20	53	30	156	38	30
Kerajegoa	19	28	0	156	2	15
Tahowrooa	20	38	0	156	36	0
Moozokinnee ...	20	39	0	156	29	30
Rannai, S. Point ..	20	46	30	156	55	30
Morotai, W. Point .	21	10	0	157	17	0
Woodhoo	21	42	30	158	1	30
Tahoora	21	42	30	160	24	30
Oreehowa ..	22	3	0	160	6	30
Oimea Road	21	57	0	159	39	30
Oneeheow	21	49	30	160	13	30
Whyteeie Bay	17	30	20	157	50	23
Owhyee, Whymea Road	21	57	30	159	41	45
Christmas, or Noel I.	1	57	45	157	35	0
Socona I. Middle ...	18	48	0	110	10	0
Cape False ...	8	40	0S.	136	30	0E.
East Point	6	20	0	148	0	0
Louisiade Isles, E.Pt.	10	35	0	154	0	0

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	S.
West Point	1	30	0S.	148	30	0E.
Stephen's Island .	0	22	0	139	39	0
Durour's Island ...	1	15	0	143	21	0
Matty's Island ...	1	45	0	143	2	0
Admiralty Islands.						
Mid. of the largest	2	18	0	146	44	0
Portland Isles, Mid.	2	27	0	148	3	0
Cape Byron ...	2	30	0	149	2	0
Duke of York I. ...	4	9	0	151	20	0
New Ireland, E. Pt.	5	0	0	152	30	0
— West Point ...	2	20	0	148	20	0
Cape St. George ...	4	53	30	152	19	0
Queen Charlotte's Foreland	2	29	0	148	27	0
Sandwich Island Peak	2	53	0	149	17	0
N. Britain, E. Pt. ..	4	53	0	153	9	0
— West Point	6	0	0	149	20	0
Port Praslin ...	4	49	27	153	6	30
Nine Islands	4	36	0	154	17	0
Bouganville Straits .	7	5	0	158	56	0
Solomon Islands.						
Cape Deception ...	8	26	0	159	14	0
Kepple's Island	10	15	0	165	4	0
Edgecomb's Island. .	11	10	0	165	14	0
Ourry's Island	11	10	0	165	19	0
Egmont Isle, C. Byron, N. E. ...	10	40	0	166	49	0
Lord Howe's Island.	11	10	0	164	43	0
New Hebrides.						
Cape Cumberland ..	14	39	30	166	47	0
Cape Queros	14	56	0	167	20	0
Leper's Island, N E.	15	16	45	168	10	45
— South West ...	15	30	0	167	45	30
Maskeylyne's Islands	16	30	0	167	58	30
	16	33	45	168	1	30
	16	32	30	167	59	30
	16	33	0	167	59	15
Mallicolo, S. Cape .	16	38	0	167	42	30
— S. W. Cape ..	16	31	0	167	36	30
Cape Sandwich ...	16	28	0	167	59	0
Sandwich Harbour..	16	25	20	167	53	0
Cape Lisburne	15	40	45	166	57	0
St. Bartholomew I.	15	42	0	167	17	30
Aurora, North end	14	52	0	168	13	0
— South end	15	24	0	168	20	45
Table Island	15	38	0	167	7	0
Whitsuntide I. N. end	15	28	30	168	21	30
— South end ...	16	0	25	168	19	0
Ambrym I N. E. end	16	4	0	168	21	25
— West end ...	16	15	0	168	3	30
Paoom	16	30	0	168	28	45
Apee, S. end ..	16	53	30	168	37	0
— N. W. end ...	16	39	0	168	18	0
Sheppard's Island From	16	56	0	168	41	25
to	17	3	30	168	43	30
Three Hill Island ..	17	4	0	168	35	0
Reef off W end...	17	8	30	168	28	30
One Hill Island ...	17	7	30	168	36	0
Two Hill Island ...	17	13	0	168	35	25
Monument .	17	14	25	168	38	25
Hinchinbroke I. ...	17	25	0	168	38	0
Montague Island ...	17	26	0	168	31	30

Names of Places.	Lat. D.	M.	S.	Lat. D.	M.	S.
Sandwich Island, From	17	29	0S	168	20	30E.
to	17	53	0	168	45	25
Traitor's Head ..	18	43	30	169	20	30
Small Island off	18	41	0	169	26	0
Immer	19	16	0	169	46	0
Tanno Island, From	19	16	30	169	21	0
to	19	38	30	169	43	0
Port Resolution ..	19	32	24	169	43	0
Inanama	19	31	0	170	21	0
Enatum	20	10	0	170	4	0
New Caledonia.						
Balleabea Island ...	20	7	0	164	22	0
Pudyoua Obs. ...	20	18	10	164	41	12
Cape Colnet ...	20	30	0	164	56	0
C. Coronation	22	5	0	167	8	0
Queen Charlotte's Foreland	22	15	0	167	12	4
Isle of Pines ..	22	38	0	167	38	0
Botany I. anch. off ..	22	26	40	167	16	45
Norfolk Island	29	1	45	168	10	0
New Zealand.						
Three Kings	34	12	0	172	12	0
Cape Maria ...	34	30	0	172	42	0
North Cape ...	34	27	0	173	5	0
Mount Camel	34	51	0	173	10	0
Cape Brent ...	35	10	30	174	40	0
Cape Colville ..	36	26	0	175	33	0
Mercury Bay ..	36	47	0	175	56	0
Cape Runaway ..	37	32	0	178	12	0
East Cape	37	42	30	179	0	0
Mount Edgecumbe .	37	59	0	166	53	0
Tolaga Bay ...	38	22	24	179	13	0
Poverty Bay ..	38	42	0	178	24	0
Albatross Point ...	38	4	0	175	18	0
Cape Table ...	39	7	0	178	24	0
Mount Edgecumb ..	39	16	0	174	45	0
Table Head	39	17	0	177	59	37
Shambles ...	39	20	0	178	20	45
Portland	39	25	0	178	12	0
Cape Kidnappers ...	39	43	0	177	36	0
Cape Turnagain	40	34	0	177	5	0
C. Stephens (I. off)	40	37	0	174	54	0
Banks's Island	43	32	0	173	30	0
Cape Saunders	45	44	0	167	48	0
South Cape	47	19	0	167	48	0
Knight's Island ...	48	15	0	166	44	0
Solander's Island ...	46	31	0	167	11	0
West Cape	45	54	0	166	43	0
Dusky Bay ..	45	47	30	166	18	9
Cape Farewell	40	33	0	174	0	0
Q. Charlotte's Ent. .	41	0	0	175	15	0
— Sound ...	41	6	0	174	18	30
Cape Campbell	41	44	0	176	15	0
Cape Pallifer ..	41	34	0	176	7	0
Point Rodney	36	15	0	175	7	0
Two Sisters ...	43	41	0	177	11	0
Skirmish Bay	43	49	0	176	35	0
Cape Young	43	48	0	176	58	0W
Friendly Isles.						
D. of York's I. ...	8	29	0	172	22	0
Wallis's Island ...	13	18	0	178	30	0
Keppel's Island	15	53	0	176	18	0
Boscawen's Island ..	15	50	0	176	15	0

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	S.
Port Refuge ..	18	18	30S.	173	56	0W
Savage Island	19	2	15	169	30	30
Agyoau ...	19	39	15	174	43	0
Hapae, North Point	19	41	0	174	37	20
Mattafoa ...	19	44	30	174	47	0
Turtle Island	19	48	45	177	57	0
Annamooka ...	20	15	2	174	51	55
Tongotaboo, Bandermain Road	21	4	15	174	56	24
Annamoke Ette ...	20	17	45	174	32	30
Commango Ette ...	20	18	20	174	28	0
Commango ...	20	19	20	174	26	0
Tonamai ...	20	28	0	174	31	30
Tellefageo	20	31	15	174	29	15
Morotoi	21	9	0	156	44	0
Eaoowe	21	20	30	174	34	0
Pylstaart's Island ...	22	23	30	174	48	0
Oheteroa ...	22	27	0	150	47	0
Toobovai ...	23	25	0	129	40	30
Palmerston Island ..	18	0	1	162	57	0
Whylotack	18	51	40	159	39	45
Harvey's Island ...	19	16	0	158	48	0
Owhyhe	19	28	12	156	26	0
Wateoo Island	20	1	30	158	14	30
Mangeea Island ...	21	56	45	185	3	0
Society Islands.						
Scilly Island ...	16	28	0	156	22	0
Ohamaneno ...	16	45	32	151	39	40
Howe's I. ..7..	16	46	30	154	6	40
Marua Island ...	16	25	40	152	32	40
Bolabola Island .	16	32	30	151	51	53
Ulietea ...	16	32	30	152	57	0
Huaheine	16	43	0	150	52	0
Owharre Harbour ..	16	44	45	151	9	40
Lord Howe's I. ...	16	46	0	155	25	0
D. of York I.	17	28	0	151	14	0
Emio	17	30	0	149	54	0
Otaheite, Obs.	19	29	15	149	32	30
Point Venus ...	17	29	20	149	36	45
Oaitepeha Bay	17	46	30	149	14	24
Osnaburg ...	17	48	0	148	10	0
Pallifer Island	15	38	15	146	30	15
Chain Island ..	17	25	0	145	38	53
Oheteroa	22	36	36	150	48	45
Toobouai ...	23	25	0	149	20	30
Taookaa Island	14	30	30	145	9	30
Adventure Island ..	17	6	20	144	17	45
Furneaux Island ...	17	11	0	143	6	40
Resolution Island ..	17	23	15	141	45	0
Bird Island ..	17	48	0	143	35	0
Groups, S. Emost. .	18	12	0	142	42	0
Bow Island, E. end.	18	23	0	141	12	0
Prince Henry's I. ..	19	0	0	141	6	0
Cumberland Island .	19	18	0	148	36	0
Gloucester Island ..	19	11	0	140	4	0
Q. Charlotte's I. ..	19	18	0	138	4	0
Egmont Island	19	20	0	138	30	0
Whitsunday Island..	19	26	0	137	56	0
Lagoon Island	18	47	0	139	28	0
Thrumb Cap ..	18	35	0	139	48	0
Osnaburg Island...	17	51	0	147	30	0
Blight Lagoon I. ..	21	38	0	140	37	0
Pitcairn's Island ..	25	2	0	133	30	0

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	S.
Oparo	27	36	0S.	144	1	32W
Hood's Island	9	26	0	138	52	0
Ohevahoa	9	40	36	139	1	22
Ohitahoo Harbour	9	55	30	139	8	40
Onateaya	9	58	0	138	51	0
Magdalena	10	25	30	138	49	0
Easter Island	27	8	30	109	51	45
Felix and Amb	27	38	0	79	45	0
Massafuero	33	15	0	80	36	0
Juan Fernandez	34	20	0	78	55	0

West Coast of America, from Icy Cape to Cape Horn.

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	S.
Icy Cape	70	29	0N.	161	42	30W
Cape Lisburn	69	5	0	165	22	30
Cape Mulgrave	67	45	30	165	12	30
Cape P. of Wales	65	45	30	168	17	0
Norton Sound	64	30	0	162	47	30
Cape Darby	64	21	0	163	0	0
Cape Stephens	63	33	30	162	16	30
Shoalness	57	37	15	162	18	15
Cape Newnham	58	41	30	162	19	30
Bristol River	58	27	0	158	7	30
Cape Grenville	57	31	0	152	37	30
Cape Elizabeth	59	11	0	152	12	0
Chiswell's Isles	59	31	0	148	50	0
Mount St. Elias	60	24	30	141	0	0
Cook's Inlet, N. end	61	29	0	148	43	0
Point Pigotess	60	47	30	147	43	30
Point Pakenham	60	59	30	147	31	0
Point Countess	60	13	0	147	29	30
Point Culroso	60	45	0	147	28	0
Point Nowell	60	27	0	147	17	30
Point Pelew	60	51	0	147	3	0
Point Freemantle	60	57	0	146	26	0
Cape Hinchinbrook	60	16	30	146	4	0
Point Riou	59	47	0	140	43	0
Knight's Island	59	44	0	139	9	0
Point Latouch	59	51	0	139	15	30
Cape Fairweather	58	50	30	137	40	0
Cape Cross	57	58	30	136	4	30
Point Dundas	58	21	0	135	59	0
Point Adolphus	58	16	0			
Point St. Mary's	58	43	30	134	58	0
Point Converden	58	12	0	134	53	0
Point Retreat	58	24	0	134	48	0
Point Parker	57	37	0	134	31	0
Point Sullivan	56	38	0	134	8	30
Point Ellis	56	30	0	134	4	0
Point Malmesbury	56	17	30	134	2	0
Point Salisbury	58	0	0	133	57	0
Point Macartney	57	1	30	133	48	0
Point Styleman	57	53	0	133	38	0
Point Windham	57	31	0	133	24	0
Cape Fanshaw	57	11	0	133	15	30
Point Hood	56	44	0	132	49	0
Point St. Alban's	56	7	0	132	42	0
Point Macnamara	56	21	30	132	46	30

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	S.
Point Blaquire	56	39	0N.	132	20	0W
Point Stanhope	56	2	0	132	22	0
Point Highfield	56	34	0	132	12	0
Point Le Mesurier	55	46	0	132	2	0
Point Warde	56	9	0	131	49	43
Cape Camaano	55	29	0	131	43	0
Point Stewart	55	38	15	131	36	0
Point Higgins	55	27	30	131	35	0
Escape Point	55	37	0	131	30	0
Point Lees	55	54	0	131	14	0
C. Northumberland	54	51	30	131	4	30
Fogg Point	54	54	30	130	49	0
Point Nelson	55	15	0	130	42	30
Cape Fox	54	45	30	130	38	0
Cape Ibbetson	54	4	0	130	30	0
Point Hunt	54	10	30	130	12	0
Point Maskelyne	54	42	30	130	15	0
Point Ramsden	54	59	0	129	57	0
Point Lambers	54	10	30	129	53	30
Banks's Island	53	26	30	129	41	0
— N. Point	53	39	30	130	13	0
Salmon Cove, Obs. In.	55	15	34	129	43	30
Fisherman's Cove	53	18	30	129	7	0
Point Cumming	53	18	30	129	2	0
Point Ashton	53	50	0	128	51	30
Point Staniforth	53	34	0	128	43	0
Cape Swain	52	13	0	128	20	0
Carter's Bay	52	48	0	128	18	0
Point Raphoe	52	43	30	127	5	0
Point Edward	52	25	30	127	22	30
Point Menzies	52	18	30	127	5	0
Cape St. James	51	58	0	130	53	30
Point Walker	51	56	30	127	51	0
Calvert's I.	51	27	0	127	55	0
Smith's Inlet (entr.)	51	18	0	127	48	30
Cape Caution	51	12	0	127	51	0
Q. Charlotte's Sound	51	4	0	127	52	0
Deep Sea Bluff	50	52	0	127	31	0
Point Boyles	50	51	0	127	8	0
Cape Scott	50	48	0	128	20	0
Woody Point	50	6	0	127	43	0
Broughton Arch.	50	35	0	126	41	0
Point Duff	50	48	0	126	50	0
Mount Stephens	51	1	0	126	40	0
Nootka Sound	49	34	20	126	28	30
Point of Breakers	49	25	0	126	28	0
Point Chatham	50	19	30	125	15	0
Point Mudge	50	0	0	124	51	0
Point Sarah	50	4	30	124	34	30
Point Marshal	49	4[illegible]	0	122	12	30
Savery's I.	49	57	30	124	5	30
Destruction I.	47	37	0	124	11	0
Scotch Firpoint	49	42	0	123	43	0
Point Upwood	49	28	30	123	36	0
Point Gower	49	23	0	123	9	0
Point Grey	49	19	0	122	54	0
Anvil I.	49	30	0	122	57	0
Point Roberts	48	57	0	122	40	0
Point Partridge	48	16	0	122	29	0
Point Wilson	48	10	0	122	29	0
Birch Bay	48	53	30	122	27	0
Strawberry Bay	48	3[illegible]	30	122	26	0
Port Discovery	48	7	0	122	39	30

Names of Places.	Lat. D.	M.	S.	Lon. D.	M.	S.
Penn's Cove	48	17	0N.	122	22	0W
Oak Cove	47	53	0	122	24	0
Poſſeſſion Sound	47	53	0	122	13	0
Point Grenville	47	22	0	124	1	30
Admiralty Inlet	47	3	0	122	42	0
Cape Diſappointment	46	19	0	123	51	0
Point Brown	47	0	0	123	53	0
Colombia River	46	19	0	123	53	0
Mount St. Helens	46	9	0	121	6	0
Reſtoration Point	47	30	0	122	14	0
Cape Lookout	45	32	0	123	49	0
C. Foulweather	44	49	0	123	56	0
Cape Perpetua	44	12	0	123	55	0
Cape Gregory	43	23	0	124	10	0
Cape Blanco	43	6	0	124	18	0
Cape Mendecino	40	10	0	124	27	0
Point D'Arena	38	56	0	123	18	0
Port Bodega	38	21	0	122	39	0
Point de Los Reys	38	0	0	122	36	0
Port St. Franciſco	37	48	30	122	7	3
Monterry	36	36	20	121	34	15
Point Sal	34	57	7	120	16	30
Port St. Diego	34	42	30	116	53	0
Point Converſion	34	9	0	118	51	0
Point Fermin	33	42	30	117	57	0
Guadaloupe, S. Point	28	54	0	118	22	0
Cape St. Lucas	22	52	0	109	44	0
Cape Corrientes	20	22	0	105	20	15
Aquapulco	17	0	0	99	59	30
Point Remedios	13	29	0	89	41	0
Realejo	12	29	0	87	3	0
Point St. Catherine	10	29	0	85	41	0
Cape Blanco	9	30	0	84	40	0
Point Burcia	8	2	0	82	55	0
Quibo I. S. E. Point	7	21	0	81	36	0
Cape Mariato	7	13	0	80	42	0
Point Mala	7	24	0	79	56	0
Panama	9	0	0	79	27	0
Cape Corentes	5	35	0	77	20	0
Point Chirambiza	4	12	0	77	20	0
Iſland Malpelo	3	56	0	80	7	0
Iſland Gorgona	2	50	0	78	15	0
Point Guicama	2	26	0	78	30	0
Point Mangles	1	36	0	78	55	0
Emerald River	0	57	0	79	30	0
Point Galera	0	48	0	79	54	0
Quito	0	13	27S.	78	10	15
Cape Paſſado	0	10	0	80	0	0
Cape de Lorenzo	1	2	0	80	59	45
Guayaquil	2	11	18	79	20	52
Paita	5	12	0	80	35	0
Truxillo	8	0	0	78	35	0
Callao	12	2	0	76	53	0
Lima	12	1	56	76	54	0
Ylo	17	36	15	71	13	0
Arica	18	26	40	70	11	0
Copeapo	27	10	0	71	0	0
Coquimbo	29	54	33	71	15	45
Valparaiſo	33	1	30	71	31	8
Conception	36	42	54	73	6	18
Mocha Iſland	38	22	30	74	37	0
Valdivia	39	51	0	73	26	30

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	S.
Chiloe, N. part	41	45	0S.	73	5	0W
— South part	43	50	0	73	5	0
Cape Deſeada	53	4	25	74	18	0
Cape Noir	54	32	30	72	3	15
Cape Horn	55	59	0	67	26	0

The Eaſt Coaſt of America, from Cape Horn to Cape Florida, with the Iſlands and Shoals adjacent.

Cape Horn	55	53	0S.	68	13	0W
Staten Iſland,						
— Cape St. John	54	47	10	63	47	0
Le Maire's Straits,						
— C. Good Succeſs	55	1	0	65	27	0
Str. of Magellan,						
Point Porpaſs	53	8	0			
Point Poſſeſſion	52	30	0	69	50	0
Cape Virgin Mary	52	24	0	69	6	0
Sta. Cruz, Harbour	50	17	0	68	28	0
Port St. Julian	49	10	0	68	44	0
Port Deſire	47	56	0	66	24	0
Cape Blanco	47	20	0	64	42	0
Port St. Antonio	40	51	0	64	40	0
Cape Corrientes	38	0	0	57	16	0
River Plate,						
— Cape St. Antonio	36	23	0	56	45	0
— Buenos Ayres	34	36	45	58	23	30
— Montevideo	34	54	48	56	13	15
St. Catherine's I.	27	21	0	48	46	0
St. Sebaſtian	23	50	0	45	16	0
Rio Janeiro	23	0	0	43	6	0
Cape Frio	23	0	0	42	10	0
Cape St. Thomas	21	42	0	41	6	0
Eſpiritu Santo	20	12	0	40	28	0
Abrolhos Shoals	18	0	0	39	28	0
Porto Seguro	16	45	0	40	27	0
B. Todas Santos	12	58	0	39	58	0
R. St. Franciſco	10	54	0	37	6	0
Cape St. Auguſtine	8	34	0	35	4	0
Pernambuco	6	48	0	35	16	0
Cape St. Roque	7	12	0	35	46	0
Cape Baxas	3	2	0	41	59	0
St. Louis de Maranham	2	27	0	45	38	0
River Para, entr.	0	30	0	48	24	0
River Amazon, entr.	0	32	0	50	46	0
Cape North	1	50	0N.	50	15	0
Cayenne	4	56	0	52	10	0
River Surinam, ent.	5	57	40	55	15	0
River Berbice, entr.	6	21	10	57	7	0
RiverDemerara, ent.	6	44	0	58	3	0
River Eſſequibo. ent.	6	55	50	58	15	0
River Oronoco, entr.	8	28	0	60	5	0
Cape Tres Puntas	10	48	30	62	45	0
Teſtigos Iſle	11	24	0	63	12	0
Margarita I. E. Point	11	0	0	63	52	0
— W. Point	11	0	0	64	30	0

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	S.
Blanca I. North End	11	52	0N.	64	41	0W
Tortuga, East end..	10	55	30	65	12	0
— West Point	10	57	0	65	25	0
Cuagua ...	10	50	0	64	16	0
Cumana	10	27	0	64	15	0
Barcelona ...	10	8	0	64	46	30
Peritu ...	10	4	0	65	16	0
Cape Codera	10	36	0	66	6	0
Guayra ...	10	37	30	66	58	0
Port Cabello	10	29	30	68	4	30
Point Tuceacas ..	10	54	0	68	19	0
Cape St. Roman ...	12	11	0	70	6	0
Orchilla I. E. Point	11	51	0	66	2	0
— West ditto ...	11	52	0	66	10	0
Rocca, East Point ..	11	59	30	66	36	0
Grande Key, E. Pt.	11	49	0	66	34	0
Salt Key, East end .	11	48	0	66	51	0
I. des Aves .	12	0	0	67	30	0
Buen Aire, N. Pt. .	12	20	0	68	25	30
Point de Lacre	11	55	30	68	18	0
Curazao,						
Savenet's Bay	12	18	0	69	12	0
St. Crux, Bay	12	12	0	69	7	30
Amsterdam Harbour	12	8	0	69	0	0
Orua Isle, E. end ..	12	24	0	69	59	0
— N. W. end	12	38	30	70	9	0
The Monks Mid. .	12	27	0	70	54	0
Cape Chivacoa.....	12	16	0	71	18	0
Cape de la Vela .	12	10	0	72	14	0
Needle Point	11	20	0	74	10	30
Carthagena ..	10	25	19	75	27	0
Island Fuerto	9	21	0	76	12	0
Pta. de S. Blas	9	35	0	78	44	0
Puerto Bello ..	9	33	0	79	33	0
Port of Cartago ..	9	19	30	80	0	0
Sandy Point	10	39	0	82	35	0
St. John's Harbour	10	41	0	83	10	0
Corn I. N. end ...	11	39	0	82	14	0
St. Andrew's Id. N. Key	12	37	0	80	48	0
Cape Gracias a Dios	15	0	0	82	46	0
Cape Camaron ..	16	1	0	85	7	0
Cape Honduras ..	16	2	0	85	54	0
Cape Three Points	15	22	0	88	39	0
Bonacca Island,						
— South West Point	16	26	30	85	54	0
Rattan I. Port Royal Harbour	16	22	20	86	27	0
Utila, East end ...	16	7	30	87	4	0
Glover's Reef, North end	16	43	0	87	37	0
Bokell Key ...	16	56	0	87	47	0
Viciosa, E. Point ..	19	0	0	84	38	0
Misteriosa, N. Point	19	41	0	84	20	0
Consumel I. N. Pt.	20	8	0	86	34	0
Loggerhead Key, N. Point	21	37	45	86	51	0
Catouch Cape	21	26	10	86	55	0
Alacran	22	25	0	89	27	0
Bermega I. Mid....	22	34	0	91	20	0
Sandy Islands	22	7	0	91	25	0
New Bank	21	50	0	91	48	0
Triangles, Nmost.	22	58	30	92	47	0

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	S.
Las Arcas	20	10	0N.	92	5	0W
Campeeche ...	20	2	10	90	25	0
Vera Cruz ..	19	5	0	96	0	0
Cape Roxo ...	21	44	0	97	10	0
Marine Bar ...	23	42	0	97	23	0
Boca Chica ...	25	21	45	97	4	0
Mouth of Rio Brava	25	53	0	97	3	0
Horse Channel ...	28	9	0	97	10	0
Point Culebas ...	29	9	0	96	52	0
Ent. of the River Missisippi. ..	29	1	0	89	10	0
New Orleans ...	29	54	30	90	9	0
St. Blas Cape ..	29	36	0	85	32	0
Egmont I. Entr. of Spiritu Santo Bay	27	37	0	82	43	0
Boca Grande, Entr. of Carlos Harbour	26	40	0	82	13	0
Cape Roman ..	26	1	0	81	50	0
— Dry Tortugas Sh.						
— S.W. Point ...	24	30	0	82	55	0
Looe Key ..	24	29	0	81	32	0
Cayo Largo ...	24	50	0	80	37	0
C. Florida ..	25	42	0	80	12	30
New Inlet ..	26	22	0	80	9	0
Granville Inlet	26	45	20	80	6	0
Hillsborough I. S.Pt.	27	16	10	80	15	0
C. Canavaral ..	28	18	0	80	30	0
Shoal off ditto, S.E.Pt.	28	13	0	80	14	0
— N. E. Point ...	28	24	0	80	12	0
St. Augustin	28	49	0	81	35	0
St. John's River, ent.	30	20	0	81	50	0
Talbot Island, S. end	30	28	0	81	57	0
Sunken Rocks, off ditto	30	22	15	81	27	0

The West-India Islands.

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	S.
I. Barbadoes, S. Pt.	13	1	30N.	59	42	0W
— Bridge T.	13	6	25	59	49	0
— Lambert's (or N.) Point	13	17	0	59	49	0
Island Tobago,						
— N. E. part ..	11	21	0	60	20	0
— Melville's Rocks	11	15	0	60	30	0
— Scarborough	11	0	0	60	43	0
— Brown's Point .	10	59	0	60	54	0
Island of Trinidad,						
— Galera Point ..	10	51	0	60	56	0
— Galgara Point ..	10	9	0	61	0	0
— Soldier's Island .	10	3	30	62	5	0
— Jaque Point	10	2	20	61	58	0
— Ape's Island .	10	42	0	61	47	0
I. Grenada, .						
— St. George .	12	1	0	61	55	0
— Salin's S. W. Pt.	11	59	0	61	57	0
— LeGrandMarquis	12	7	5	61	42	0
— Goave .	12	12	0	61	54	0
GrenadaBk. with only 3 Fathom about the Middle of it ..	11	55	0	62	21	0

Table XXVII. Of Latitudes and Longitudes.

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	S.
Grenadines,						
Isle Levera	12	17	30N.	61	42	0W
Isle Ronde	12	21	0	61	41	0
Carriacou	12	28	30	61	31	0
Little Martinico	12	31	0	61	28	0
Union	12	36	0	61	32	0
Sail Rock	12	40	20	61	27	0
Maycro	12	40	0	61	28	0
Canouan	12	42	30	61	27	0
Moustiques	12	51	10	61	18	0
Ballefo	12	55	0	61	16	0
Ballewya	12	58	15	61	15	0
Bequia	13	0	0	61	24	0
Young's Island	13	7	0	61	21	0
I. St. Vincent,						
— Kingstown, N. P.	13	9	0	61	23	0
— Chateau Belair, S. P.	13	17	0	61	22	0
— Spanish Point	13	21	15	61	19	0
— Point Colonery	13	12	0	61	16	0
— Rabishi	13	9	0	61	18	0
Isle St. Lucia,						
Cape Grose Le Cap	13	56	0	61	6	0
Cape Sable	13	42	0	61	5	0
Moulacique Point	13	33	15	61	10	0
Pitton Point	13	37	0	61	18	0
Martinico,						
— *Fort Royal	14	37	10	61	9	0
— St. Pierre	14	45	50	61	18	0
— Pearl Rock, W. Pt.	14	51	0	61	24	0
— Point Caravella	14	45	0	60	59	0
— Point Salines, S.E. P.	14	26	0	60	57	0
— Diamond Rock	14	30	0	61	13	0
Dominica,						
— *Scott's Head	15	14	30	61	31	0
— Roseau	15	18	45	61	32	0
— Prince Rupert's Bay	15	32	0	61	38	0
— Point Jaquet	15	36	0	61	37	0
— Mulatto Point	15	18	20	61	27	0
Marygalante,						
— Town	15	54	30	61	30	0
— Sunken Rocks off ditto, S. E. Pt.	15	51	0			
Guadaloupe,						
— S. Point	15	57	0	61	40	0
— N. Point	16	22	0	61	45	0
— Grand Terre, S.E.P.	16	13	0	61	8	0
North Cape	16	29	30	61	26	30
Deseada, N. E. Pt.	16	21	0	61	2	0
— S. W. Point	16	13	0	61	5	0
— Saints Islands	15	53	0	61	37	0
Montserrat,						
— North East Point	16	47	50	62	9	0
— Redonde	16	56	0	62	20	0
Antigua, E. Point	17	6	0	61	40	0
— English Harbour	17	2	0	61	46	0
Barbuda, North Pt.	17	43	0	61	50	0
St. Christopher, S. E. Point	17	12	0	62	36	0
— Basse Terre	17	18	0	62	40	0
— Nevis Town	17	7	0	62	35	0
— Saint Eustatius, Town	17	30	30	63	0	0
— Island Saba	17	39	30	63	12	0

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	S.
St. Bartholomew,						
— East Point	17	54	0N.	62	46	0W
St. Martin, S Point	18	0	0	63	4	0
— North Point	18	8	30	63	2	0
Anguilla, N. E. Point	18	18	0	63	0	0
— Prickly Pear	18	20	0	63	13	0
Santa Cruz,						
— East Point	17	45	0	64	30	0
— S.W. Point	17	38	30	64	49	30
Virgin Islands,						
— Anegada, W. Pt.	18	46	0	64	21	0
— Horse Shoe, with only from 2 to 6 Feet off ditto, S. E. Point	18	33	0	64	6	0
Virgin Gordo, E. end	18	31	0	64	13	0
Tortola, W. end	18	25	30	64	40	0
St. John's, S. Pt.	18	20	0	64	39	0
Bird's Key	18	15	0	64	47	0
St. Thomas, E. Pt.	18	18	0	64	46	0
Bequa, or Crab Island,						
— East Point	18	9	30	65	12	0
Porto Rico,						
— Cape St. Juan, N. E. Point	18	23	0	65	33	0
— Cape Mala Pasqua	17	58	0	65	43	0
Los Morrillos	17	58	0	67	7	0
Point Bruquen	18	30	20	67	4	0
Mona Island, E. Pt.	18	3	45	67	44	0
St. Domingo,						
Saona, East Point	18	12	30	68	28	0
Alto Vela	17	26	30	71	19	0
Abacou Point	18	2	18	73	44	0
Cape Tiberon	18	20	0	74	29	0
Cape Donamaria	18	36	0	74	25	0
Port au Prince	18	31	5	72	18	0
C. St. Nicholas Mole	19	50	0	73	21	0
Point Isabella	19	58	45	71	10	0
Old Cape Francois	19	39	0	69	51	0
Cape Cabron	19	22	30	69	11	0
Cape Raphael	19	1	30	68	51	0
Cape Enganio, or False Cape	18	33	0	68	18	0
St. Domingo Town	18	26	30	69	48	0
Tortuga, E. Point	20	1	30	72	32	0

Islands and Shoals North of Jamaica and Cuba.

Names of Places.	Lat. D.	M.	S.	Long. D.	M.	S.
East Reef, Middle of it	20	6	30N.	68	40	0W
Superb Shoal, Middle	20	58	0	69	0	0
Silver Keys, Southern Reef	20	14	0	67	27	0
North East Point of ditto	20	30	0	69	23	0
Western Edge, Silver Keys	20	28	0	69	57	0
Square Handkerchief,						
— N. E. Point	21	4	0	70	27	0
— S. W. ditto	20	52	15	70	54	0

Names of Places.	Lat. D. M. S.	Long. D. M. S.
Grand Turk Island, — N. E. end	21 32 0N.	71 3 0W
Sand Key, Middle	21 10 30	71 10 0
Great Caycos Island, — South Point	21 32 15	71 26 0
Cape Comet	21 43 0	71 24 0
Caycos Shoal, S.E. Pt.	20 58 20	71 31 0
——————S.W.Pt.	20 58 0	71 51 0
Little Caycos Island, North Point	21 41 0	72 26 0
Providence Caycos I. North End	21 49 0	72 19 0
Heneaga Id. N.E. Pt.	21 17 30	73 2 0
———— S. E. do.	20 59 30	73 4 0
———— S. W. do.	20 52 0	73 39 0
———— W. do.	21 7 0	73 37 0
Little Heneaga Island, — East Point	21 28 0	72 56 0
Hogsties, Middle part	21 38 0	73 49 0
Mayaguana Id. S. Pt.	22 15 25	72 47 0
———— N. W. do.	22 27 20	73 6 0
———— S. W. do.	22 22 0	73 8 0
French Keys, Middle	22 38 0	73 30 0
Atwood's Key, N.E Pt.	23 10 30	73 32 0
Castle Island	22 6 30	74 16 0
Crooked I. N.W. Pt.	22 47 30	74 13 30
Mira Para, Vos Keys, Middle	22 5 0	74 28 0
Watland Island, S. end	23 55 0	74 34 0
Rum Key, Middle	23 33 30	74 56 0
Little Island, S. end	23 49 30	75 16 0
Key Verde	22 0 0	75 3 0
Yuma I. S. E. Point	22 50 40	74 45 0
— North end	23 30 0	75 19 0
Gunahana I. S. Pt.	23 58 0	75 30 0
— North Point	24 37 30	75 47 0
Powel's Point	24 38 0	76 34 0
Egg Island	25 27 0	77 24 0
New Providence, Nassau Town	25 4 0	77 37 0
Andros I. N. Point	25 25 0	78 22 0
— South Point	24 4 0	78 7 0
Great Isaac I. N. Pt.	25 55 0	79 20 0
Cat Keys	25 24 0	79 18 30
Hole in the Wall	25 58 0	77 35 0
Little Baham Bank, N. W. Point	27 48 0	79 15 0
Memory Rock	27 4 0	79 6 0
Orange Keys, Mid.	24 33 30	79 9 0
Double-headed Shot Keys, W. Point	23 56 20	80 12 0
Anguilla, S E. Pt.	23 29 0	79 12 0

Island of Jamaica.

Names of Places.	Lat. D. M. S.	Long. D. M. S.
Morant Pt. S. E. end	17 58 0N.	76 7 30W
Port Royal	17 57 0	76 53 0
Portland Point	17 42 0	77 12 0
South Negril	18 15 0	78 35 0
Montego Bay	18 32 0	78 7 0
Galina Point	18 30 0	76 57 0
Port Antonio	18 14 0	76 27 0

Names of Places.	Lat. D. M. S.	Long. D. M. S.
Morant Keys, N. E. Point	17 26 0N.	75 57 0W
— S. W. Point	17 22 0	76 0 0
Formigas Shoal, Mid.	18 31 30	75 45 0
Portland Rock	17 11 0	77 12 0
Little Cayman I. S. Point	19 40 0	79 47 0
Great Cayman, E. Pt.	19 28 0	80 36 0
— S. W. Point	19 27 0	81 3 0
Swan Island, Middle	17 24 0	83 35 0

Island of Cuba.

Names of Places.	Lat. D. M. S.	Long. D. M. S.
Cape Maysi	20 13 0N.	74 0 0W
Cumberland Harbour	19 53 10	75 12 0
Cuba	19 57 0	76 4 0
Cape Cruz	19 48 30	77 38 0
Isle of Pines, S.W. Pt.	21 19 0	82 54 0
Cape Corientes	21 42 15	84 23 0
Cape Antonio	21 55 0	84 55 0
Honda Bay	22 54 10	83 6 0
Havannah	23 8 20	82 17 0
Pan Matanzas	23 0 0	81 35 0

United States of America.

Names of Places.	Lat. D. M. S.	Long. D. M. S.
Cumberland I. S. end	30 44 15N.	81 58 0W
Savannah River, ent.	32 3 0	81 0 0
Port Royal, ent.	32 12 0	80 44 0
Castletown Light	32 45 0	80 5 0
Cape Roman	33 3 30	79 28 0
George Town	33 27 20	79 25 0
Cape Fear	33 50 15	78 29 0
Frying-pan Shoal, off ditto	33 31 30	78 18 0
Cape Lookout	34 23 0	77 10 0
Shoal off ditto	34 9 0	77 5 0
Cape Hatteras	35 8 0	76 2 0
Shoals off ditto	34 47 30	75 27 0
Cape Henry	36 57 0	76 10 0
Cape Charles	37 12 0	76 2 0
Chingoteak Island	38 0 0	75 20 0
Thirteen Feet Bank off ditto	38 6 20	74 47 0
Cape James	38 46 30	75 8 0
Cape May	39 0 0	74 58 0
Philadelphia	39 56 30	75 17 0
Sandy Hook Lighth	40 26 30	74 6 0
New York	40 41 45	74 8 0
Montuk Point	40 5 0	72 6 0
Block Island	41 11 0	71 46 0
Point Judith	41 23 0	71 38 30
Newport, Rhode I.	41 29 0	71 15 0
Gay Head	41 22 0	70 57 30
Sandy Point Lighth. Nantucket Island	41 21 0	70 4 0
Southern Breakers	40 43 30	70 9 0
Cape Cod Lighthouse	42 5 0	70 18 0
Boston Lighthouse	42 22 0	70 54 0
Boston Town	42 19 0	71 5 0
Marble Head	42 32 9	70 54 0

Names of Places.	Lat. D.	M.	S.	Long. D.	M.
Salem	42	34	20N.	70	55W
Baker's Island Light	42	35	25	70	50
Cape Anne Lighth. Thatcher's Island	42	40	10	70	39
Newberry PortLights	42	48	30	70	51
Portſmouth Town	43	5	15	70	45
Isles of Shoals	42	57	0	70	38
Boon Island	43	6	0	70	32
Cape Elizabeth	43	33	20	70	12
Portland Lighthouſe	43	39	0	70	12
Cuſh's Ledge, Mid. Reef	43	5	0	69	13
Seguin Island	43	41	20	69	47
Kennebeck River, entrance	43	43	0	69	47
Bantam Ledges	43	42	15	69	9
Manheigin Island	43	44	25	69	21
Martinicus Island	43	50	0	69	1
Mount Deſert Rock	43	52	0	68	11
Grand Manan Iſland, Weſt end	44	30	0	67	9
Wolves Iſlands	44	47	50	66	55
Iſland of Campo Bello, or Weſt Paſſage, Paſſamaquady Bay	44	50	0	67	9
Sante Croix River	45	0	0	67	6

From the River St. Croix to Cape Canſo in Nova Scotia.

Names of Places.	Lat. D.	M.	S.	Long. D.	M.
Mocgone's Iſland, entr. of St. John's River	45	18	20N.	66	4W
C. Spencer	45	17	16	65	55
C. Chignecto, entr. of Baſon of Mines	45	24	20	64	49
Hauto I.	45	19	12	64	52
Annapolis Royal	44	47	10	65	55
Breyer's Iſland	44	19	0	66	25
St. Mary's Cape	44	10	15	66	12
C. Forchu	43	52	20	66	9
Seal Iſles	43	27	45	66	0
C. Sable	43	27	11	65	35
Port Roſeway	43	40	15	65	17
Iſle of Hope	43	53	10	64	44
Port Jackſon	44	13	0	64	27
Charlotte Bay	44	34	25	63	55
C. Sambro Lighthouſe	44	30	15	63	32
Halifax Harbour	44	36	10	63	28
Port Stephens	45	0	45	61	58
Sandwich Bay	45	8	50	61	36
Torbay	45	12	20	61	16
Port Howe	45	13	30	61	5
C. Canſo	45	16	0	60	55
Sable I. Eaſt Point	44	8	25	60	0
—— Weſt ditto	44	4	15	60	35

The Gulf of St. Lawrence.

Names of Places.	Lat. D.	M.	S.	Long. D.	M.
St. Paul's Iſland	47	11	15N.	60	0W
Bird Iſlands	47	55	20	60	41
Brion I.	47	52	10	61	0
Magdalen I. N.E.P.	47	41	0N.	61	0W
—— S.W. ditto	47	12	5	61	41
Entry I.	47	15	30	61	21
Deadman's I.	47	15	20	61	53
I. of Antecoſta, E. P.	49	8	35	61	39
—— S.W. ditto	49	22	15	63	23
—— Weſt ditto	49	48	20	64	23
—— North ditto	49	53	10	64	0
I. de Bik, in the River St. Lawrence	48	32	15	67	55
Mount Camille	48	37	20	67	20
C. St. Ann	49	3	0	66	55
Magdalen River	49	13	15	65	18
C. Rozièr	48	47	10	64	1
C. Gaſpe and Bay	48	41	20	63	58
Flat Point	48	34	0	63	58
I. Bonaventure	48	24	11	63	58
C. Deſpair	48	28	5	64	6
Miſcou I. entrance of Chaleur Bay	48	0	20	64	21
P. Eſcuminac	47	1	45	64	42
St. John's Iſle, N. Cape	47	2	20	63	54
—— Weſt Point	46	34	15	64	16
—— Eaſt ditto	46	27	0	61	53
—— Bear Cape	46	0	10	62	18
Hillſborough Bay	46	6	12	63	0
Cape St. George	45	51	15	61	49
Gut of Canſo, N. entr.	45	42	20	61	27
Juſta Corp I.	45	56	10	61	27
Port Hood	45	57	0	61	25
C. North I. off C. Breton	47	1	5	60	15
Port Dauphin	46	23	30	60	18
Spaniſh Bay	46	18	15	60	2
Flint Iſland	46	11	35	59	38
Scatari I.	46	2	10	59	32
C. Breton	45	57	40	59	44
Louiſburg	45	54	0	59	54
C. Hinchinbroke	45	34	15	60	29
Iſle Madame	45	29	30	60	49
Gut of Canſo, S. entr.	46	28	30	60	51
Chedabucto Bay	46	23	10	60	51

Newfoundland.

Names of Places.	Lat. D.	M.	S.	Long. D.	M.
Limits of the Great Bank of Newfoundland, N. Point	50	15	20N.	50	0W
Ditto, South Point	41	0	0	52	0
Outer, or Falſe Bank	47	0	15	45	0
Virgin Rocks	46	30	10	51	35
Cape Race	46	42	30	52	49
Cape Ballard	46	49	20	52	42
Cape Broyle	47	7	15	52	35
Bay of Bulls	47	21	16	52	29
Cape Spear	47	30	20	52	20
St. John's Harbour	47	32	20	52	25
Cape St. Francis	47	54	15	52	30
P. of Grates	48	22	0	52	35
Trinity Bay	48	30	40	53	5
Cape Bonaviſta	48	52	30	52	40
Barrow Harbour	48	50	0	53	5
Funk Iſland	50	1	15	52	17
Cape Freels	49	34	10	53	0

Names of Places.	Lat. D.	M.	S.	Long. D.	M.
Wadham Iſlands	49	54	5N.	53	30W
Gander Bay	49	40	16	54	15
Fogo Iſland	50	0	12	53	54
Twillingate Iſlands	50	3	20	54	40
Bay of Notre Dame	50	0	0	55	35
Cape Sr. John	56	10	0	55	38
Horſe Iſlands	56	21	45	56	51
White Bay	50	15	15	56	25
Hooping Harbour	50	46	0	56	18
Green Iſland	50	47	20	55	35
Groais Iſland	50	55	5	55	45
Hare Bay	51	15	10	56	1
St. Anthony's Cape	51	17	30	55	44
Quirpon Harbour	51	40	20	55	39
Belleiſle	51	55	15	55	30
Cape Norman	51	40	5	56	2
Bay St. Barbe	51	15	17	56	53
Point Ferolle	57	3	0	57	11
St. John's Iſland	50	50	20	57	23
Ingornachoix Bay	50	38	30	57	25
Bay St. Paul	49	50	50	57	55
Cape St. Gregory	49	22	15	58	17
South Head	49	7	40	58	26
Cape St. George	48	30	45	59	13
Cod Roy Iſland	47	52	10	59	23
Cape Ray	47	37	0	59	15
Great Barriſway	47	37	15	57	45
Burgeo Iſlands	47	35	0	57	37
Runney Iſland	47	32	20	57	30
Penguin's Iſlands	47	24	15	57	[illegible]5
Fortune Bay	47	16	10	55	35
Burnet	47	15	35	56	1
Great Miquelon	46	55	15	56	21
Langley Iſland	46	42	20	56	20
St. Peter's Iſland	46	36	10	56	11
Cape Chapeau Rouge	46	52	0	55	22
Bay of Placentia	47	0	10	54	35
Cape St. Mary's	46	52	5	54	7
St. Mary's Bay	46	50	15	53	35
Cape Pine	46	40	20	53	20

From Quebec to Hudſon's Bay.

Names of Places.	Lat. D.	M.	S.	Long. D.	M.
Quebec	46	55	11N.	69	53W
St. Paul's Bay	47	30	20	69	15
Bay of Rocks	48	5	15	68	43
Laval Bay	48	55	30	68	50
St. Nicholas's Bay	49	28	41	67	5
Trinity Bay	49	37	24	66	32
The Seven Iſland Bay	50	7	16	65	50
Grand Bay, St. John's	50	22	5	64	5
Mingan I.	50	16	10	63	20
Eſquimaux Iſlands	50	12	30	63	5
Mount Joli	59	5	0N.	61	35W
Little Mecatina Iſland	50	28	15	59	32
Great Mecatina Point	50	52	14	59	13
Haha Bay	50	52	20	59	7
Eſquimaux Bay	51	28	10	57	50
Grand Point	51	24	0	57	17
Forteau Bay	51	30	20	57	0
Red Cliffs	51	33	40	56	50
Black Bay	51	40	20	56	47
Red Bay	51	44	5	61	25
York Point	51	57	10	55	57
Cape Charles	54	13	12	55	30
Great Bay of Eſquimaux	54	20	0	57	35
Cape Harriſon	54	54	15	56	50
St. Peter's Harbour	56	28	10	60	50
Inchanted Cape	56	40	20	60	55
Saddle Iſlands	57	13	30	60	50
Eaſt Iſland	57	45	0	61	20
Steel Point	58	7	10	61	50
Cardinal's I.	58	50	40	63	0
Falſe Black Head	59	20	20	69	19
Black Head	59	50	15	63	37
Button's Iſlands	60	47	50	65	21

Hudſon's Bay.

Names of Places.	Lat. D.	M.	S.	Long. D.	M.
Button's Iſlands	60	47	5N.	65	21W
Lowe's Savage Iſland	61	48	20	66	25
Terra Nieva	62	4	30	68	5
Saddle Back Iſland	62	10	10	68	15
Great Bear Island	54	4	20	80	1
Ice Cove	62	0	0	69	5
Baker's Dozen	57	0	5		
Great Savage Island	62	25	25	70	5
North Bluff	62	26	15	71	15
God's Mercies	62	28	0	70	53
Saliſbury Island	63	30	45	76	55
Nottingham, E. end	63	35	30	76	50
Cape Charles, E. end	62	50	22	74	20
— Weſt end	62	40	5	76	5
Cape Walſingham	62	40	10	78	5
Cape Diggs	62	45	20	78	53
Mansfield, N. end	62	40	15	78	5
— South end	61	35	20	81	35
Sleeper's Island	60	10	40	81	35
Great ditto	58	35	25	81	35
Cape Pembroke	62	57	15	82	15
Large Swan's Neſt	62	20	6	83	35
Cape Southampton	62	10	0	86	15
Churchill River	58	47	10	94	12
Charton Island	52	3	10	79	10
Port Nelſon's Shoals	57	35	15	92	35
Hay River	57	10	20	93	5

A GENERAL TIDE TABLE,

Shewing the Times of High Water at the Full and Change of the Moon, at the principal Places on the Coasts of EUROPE and AMERICA.

N. B. *r.* denotes the vertical rise of spring tides, and *ft.* feet.

	H.	M.
Aaron Island, France; *r.* 45 *ft.*	6	30
Abbeville, France	10	30
Abb's Head, (St.) (*offing,*) Scotland	4	30
Aberdeen, Scotland	12	45
Aberdovy, Wales; *r.* 18 *ft.* ..	7	30
Abrevrack, France ..	4	30
Achill Head, Ireland . ..	6	0
Adventure Bay, North Holland	4	36
Agnes Lighthouse, (St.) Scilly	3	45
Aix, France	3	0
Alban's Head, (St.) England ..	7	30
Aldborough Bay, England; *r.* 10 *ft.*	10	45
Alderney Island, British Channel; *r.* 28 *ft.*	6	0
Alemouth, Scotland . ..	2	15
Alloa, Scotland ..	2	30
Altona, Germany	6	0
Amazon's River, America ..	6	0
Ambleteuse, France ..	11	0
Ameland I. German Ocean ..	10	30
Amelia Harbour, America ..	9	0
Almwch Port, Anglesea; *r.* 24 *ft.*	10	30
Amsterdam, Holland; *r.* 7 *ft.*	3	0
Angra Bay, Terceira, Açores; *r.* 8 *ft.*	11	45
Anholt Island, Denmark ..	12	0
Ann Cape, America; *r.* 12 *ft.*	11	30
Annamocka, Pacific Ocean .	6	0
Anticosti, West end . ..	3	30
Antwerp, Brabant	6	0
Arbroath, Scotland . ..	1	45
Archangel, Russia	6	0
Archangel River (entrance of) White Sea	6	30
Arklow, Ireland	8	15
Arran Isle, Scotland; *r.* 9 *ft.*	11	15
Arundel, England; *r.* 16 *ft.*	9	20
Avranches, France ..	6	0
Ayre Point, Isle of Man ..	10	30
Babelmandel (Straits of) Red Sea	12	0
Balasore Road, India; *r.* 12 *ft.*	10	30
Ballinskellik's Bay, Ireland	3	15
Balley Castle, Ireland ..	5	45
Baltimore, Ireland ..	3	45
Bantry Bay, Ireland .. .	3	45
Bardsey Isle, Wales ..	8	15
Barfleur, (Cape) France .	7	30
Barmouth, Wales; *r.* 14 *ft.*	7	45

	H.	M.
Barnstaple Bar, England; *r.* 26 *ft.*	5	50
Bas (Isles of) British Channel; *r.* 27 *ft.*	3	45
Baudsey Cliff, England ..	10	30
Bayeux, France . .	8	15
Bayonne, Spain . ..	4	45
Bayonne, France	3	30
Beachy, on the Shore, England; *r.* 20 *ft.*	9	45
Beachy Head, (*offing*) England	11	0
Bear Island, Hudson's Bay	12	0
Beaumaris, Wales; *r.* 24 *ft.*	10	15
Bee's Head, (St.) England ..	11	0
Belfast, Ireland . ..	10	30
Belle Isle, Bay of Biscay .	3	0
Bembridge Point, Isle of Wight	11	40
Bergen (N.) and thence to the Stadtland, Norway ..	1	30
Bermudas I. Atlantic Ocean; *r.* 5 *ft.*	7	0
Berwick, England; *r.* 16 *ft.* ..	2	15
Bic Island, Canada ..	2	0
Biddeford, England ..	6	0
Bilboa, Spain; *r.* 15 *ft.* ..	3	15
Biscay, Coast of, Spain ..	3	45
Blakeney, England; *r.* 16 *ft.*	7	30
Blanco Cape, Africa ..	9	45
Block Island, America; *r.* 5 *ft.*	7	37
Blythe, England; *r.* 12 *ft.*	2	45
Boggy, or Bog Point, Devon, England	5	20
Bojador, (Cape) Africa ..	12	0
Bolt Head, England; *r.* 20 *ft.*	5	55
Bombay, India . .	11	15
Borkum Isle, German Ocean	10	30
Boston, England . ..	7	15
Boston, (Lighthouse) America; *r.* 12 *ft.*	11	30
Botany Bay, N. Holland	8	0
Botany Island, N. Caledonia	10	30
Boulogne, France . ..	10	45
Bourdeaux Road, (entrance) and thence to Ushant, France	3	45
Bray Head, Ireland ..	3	30
Bree Bank, Flanders ..	3	30
Bremen, Germany ..	6	0
Brest Harbour, France ..	3	45
Bride's Bay, (St.) Wales ..	6	0
Bridgewater, England; *r.* 22 *ft.*	6	45

	H.	M.
Bridlington or Burlington, England; r. 13 *ft.*	4	30
Brighthelmſtone, England; r. 16 *ft.*	10	6
Brill, Holland; r. 20 *ft.*	1	50
Briſtol, England	6	45
Buchan Neſs, Scotland	12	0
Burry Iſland, Wales; r. 24 *ft.*	6	30
Buſtard Bay, New Holland; r. 8 *ft.*	8	0
Button's Iſles, Hudſon's Bay	6	50
Cadiz, Spain	4	0
Caernarvon Bar, Wales; r. 22 *ft.*	9	0
Calais, France; r. 18 *ft.*	11	30
Calcutta, India	3	5
Caldey Iſle, Wales; r. 34 *ft.*	6	0
Calf of Man, Iriſh Sea	10	30
Callao, Port of Peru	6	30
Camperdown, Holland	4	30
Canaria Iſland, Atlantic Ocean	3	6
Cancale, France	7	30
Canſo Cape, America	8	30
Cantire, (Mull of,) Scotland; r. 5 *ft.*	9	0
Cape Ann, America; r. 12 *ft*,	11	30
—— Charles, America	7	0
—— Churchill, Hudſon's Bay,	7	30
—— Clear, Ireland	3	0
—— Cod, America; r. 6½ *ft.*	11	30
—— Cornwall, England; r. 22 *ft*	4	25
—— Corunna, Spain	3	0
—— Donega, White Sea; r. 6 *ft.*	6	0
—— Fear Bar, America	7	10
—— Finiſterre, Spain	3	0
—— Grizneſs, France	11	0
—— La Hogue, France	12	0
—— Henlopen, America; r. 5 *ft.*	8	54
—— Henry, America; r. 4 *ft.*	7	0
—— St. Mary, Nova Scotia; r. 14 *ft.*	9	0
—— May, Delaware, B. America,	8	0
—— Ortegal, Spain	3	0
—— Sable, Nova Scotia; r. 9 *ft.*	8	0
Cappel, (Weſt,) Holland	12	30
Cardiff, Wales	6	0
Cardigan Bar, Wales; r. 20 *ft.*	7	0
Carlingford, Ireland; r. 14 *ft.*	9	0
Carliſle, England	12	0
Carmarthen Bar, Wales; r. 24 *ft.*	6	30
Carrickfergus Bay, Ireland; r. 8 *ft.*	10	30
Caſkets, Brit. Channel; r. 28 *ft.*	8	0
Catherine's Point, (St.) Iſle of Wight	8	30
Catneſs or Catſnoſe, White Sea,	5	15
Charleſtown, America; r. 6 *ft.*	7	0
Chatham, England	1	0
Chepſtow, England	7	30
Cherbourg, France; r. 20 *ft.*	7	30

	H.	M.
Cheſter Bar, England; r. 26 *ft.*	10	30
Chiloe Iſland, South America	12	30
Chittagong Bar, India	1	0
Chriſtmas Sound, South America	2	30
Chriſtmas Harbour, Kergulen's Land	10	0
Coaſt, (Cape) Africa	3	30
Condore, (Pulo) China Sea; r. 7 *ft.*	4	16
Copeland Iſland, Ireland	10	30
Coquet Iſland, England; r. 15 *ft.*	2	45
Cork Harbour, (entr.) Ireland; r. 18 *ft.*	4	30
Cornwallis Port, P. of Wales's Iſland; r. 10 *ft.*	1	30
Cornwallis Port, Andaman I.	10	0
Cowes, Iſle of Wight; r. 15 *ft.*	11	15
Cracatoa, (I.) Straits of Sunda; r. 3 *ft.*	7	0
Cromarty, Scotland; r. 14 *ft.*	11	45
Cromer, England; r. 16 *ft.*	6	45
Crookhaven, Ireland	3	0
Croſs Iſland, White Sea	4	15
Cumbry Lighthouſe, Scotland	11	0
Curreuſe Iſland, Almorantes	5	10
Dartmouth, England, r. 18 *ft.*	6	0
David's Head, (St.) Wales	6	0
Deal, England; r. 15 *ft.*	11	0
Delaware River, (ent.) Amer	9	0
Denbigh, Wales	2	15
Dieppe, France; r. 18 *ft.*	10	30
Dingle Bay, Ireland	3	30
Donegal, Ireland	6	30
Dorſes, Ireland	3	0
Dort, Holland	3	0
Dover Road, England; r. 14 *ft.*	11	6
Douglas, I. of Man; r. 21 *ft.*	10	30
Downs, England; r. 15 *ft.*	11	0
Drogheda, Ireland	10	43
Dronthiem, and along the Coaſt of Finmark to the N. Cape	2	15
Dublin, Ireland; r. 12 *ft.*	9	45
Dunbar, Scotland	1	30
Duncanſley Head, Scotland	10	30
Dundalk Bay, Ireland	10	45
Dudgeon Light, North Sea	7	30
Dundee, Scotland	2	30
Dungarvon, Ireland	4	30
Dungeneſs, England; r. 24 *ft.*	10	51
Dunkirk, Flanders; r. 18 *ft.*	11	15
Dunnoſe I. of Wight	8	55
Durſey Iſland	3	30
Duſkey Bay, N. Zealand	10	57
Dyſart, Scotland	2	15
Eaoowe, Pacific Ocean	7	0
Eagle Iſland, Aſia	3	30
Eaſter Iſland, Chili	2	0
Eddyſtone, Britiſh Channel; r. 18 *ft.*	5	50
Egmont, Holland	4	30
Elbe, (red Buoy,) German Ocean	12	0

	H.	M.
Elizabeth Island, America	9	0
Embden, Germany -	12	0
Endeavor River, N. Holland	1	30
Before the Eastern and Western Ems, German Ocean -	9	0
Etaples, France -	3	15
Exmouth Bar, England, r. 14 ft.	6	25
Eyden River, German Ocean,	12	0
Exuma Bar, Bahamas -	6	35
Eyemouth Harbour, Scotland,	2	15
Fair Isle, North Sea -	4	0
Falkland Island, America -	5	0
Falmouth, England; r. 18 ft.	5	45
False Bay, Cape of Good Hope	2	0
Fayal Road, Açores; r. 4½ ft.	2	20
Fearn Island Light. North Sea	3	30
Ferolle Point - -	11	15
Fifeness, Scotland -	4	30
Finisterre (Cape) to Cape St. Vincent - -	2	30
Finmark (Coast of) in general,	2	15
Flamborough Head and Filey,	4	30
Flats (Kentish), England -	12	0
Flatholm Island, Bristol Channel	6	40
Flemish Banks, North Sea -	3	0
Florida Keys, America -	8	50
Flushing, Holland -	1	0
Fly (or Vlie) Gateway, Holland - -	6	45
Fly, or Vlie, Road, Holland -	7	30
Folkstone, England; r. 20 ft. -	10	51
Fort George, Scotland -	12	0
Fort St. John, Newfoundland	9	0
Forteau Bay, America -	11	0
Foul Isle, near Shetland -	3	0
Fowey, England; r. 16 ft. -	5	30
Frith of Tain, Scotland -	11	0
Funchall, Madeira; r. 7 ft. -	10	30
Gallopper and Gabbard, Thames Mouth; r. 16 ft. -	12	45
Galway Bay, Ireland -	4	30
Galloway, (Mull of,) Scotland	11	15
Gambia, (River, ent.) Africa	10	15
Gaspe Bay, America -	1	30
Gay Head, America; r. 7 ft.	7	37
George's River, America; r. 9 ft. - -	10	45
George Town Bar, America -	6	40
Gibraltar, Spain - -	12	0
Glasgow Port, Scotland -	11	30
Goa, India - -	4	30
Goodwin Sands, Back of the,	1	30
Gore, near Margate, England,	12	0
Goree Gatway, German Ocean,	1	30
Grangemouth, England -	2	30
Granville, France -	7	30
Gravelines, France; r. 18 ft. -	11	45
Gravesend, England; r. 16 ft	1	30
Gresholm, near Milford Haven,	7	30
Guayaquil (Port) South America	6	30
Guernsey, British Channel; r. 30 ft. - -	6	0
Gulf of Corryvrechan, Lewises; r. 11 ft. - -	4	30
Gut of Canso, America -	8	30
Haerlem, Holland -	9	0
Hague, Holland - -	8	15
Hogue, (Cape La,) France; r. 16 ft. - -	8	45
Halifax, Nova Scotia; r. 8 ft.	7	30
Hamburgh. Germany -	6	0
Hampton Quay, England -	12	0
Hanford Water, England; r. 16 ft. - -	12	0
Hartland Point, England -	6	0
Hartlepool, England -	3	45
Harwich, England; r. 14 ft.	11	30
Hasborough, England -	7	30
Hasborough Sand, North Sea -	8	0
Hastings, England -	10	36
Havre de Grace, France; r. 22 ft. - -	10	30
Helena, (St.) Atlantic Ocean	2	15
Helena, (Cape St.) America	4	0
Helford, England; r. 18 ft.	5	15
Heilegoland, German Ocean,	12	0
Helen's (St.) England; r. 16 ft.	11	45
Helvoetsluys, Holland -	1	30
Henlopen, (Cape) America	8	54
Henriette Marie, (Cape,) Hudson's Bay - -	12	0
Holms, (Flat and Steep,) Bristol Channel; r. 36 ft. -	6	40
Holy Head Bay, Wales; r. 24 ft.	10	0
Holy Island Harbour, Scotland; r. 15 ft. - -	2	30
Honfleur, France - -	9	0
Hook of Holland -	3	0
Heoringottah River, East-Indies	12	0
Horn, (Before the,) German Ocean - -	12	0
Horse Race, America; r. 5 ft.	10	30
Hosley Bay, England, r. 11 ft.	11	0
Hull, England; r. 18 ft. -	6	0
Humber (Entr.) England -	5	15
Hung Road, England; r. 46 ft.	6	45
Hurst Castle, England -	9	30
Ice Cove, Hudson's Bay -	10	0
Ila, (E. side and Sound of;) r. 5 ft. - -	3	15
Ilfordcombe, England -	6	0
Ingella, India - -	11	0
Inverkeithing, Scotland -	2	45
Ipswich, England -	12	0
Ireland, N. W. Coast, from Milen Head to Balliconnel; r. 12 ft. - -		
———, W. Coast in general,	3	0
———, Havens on the S. Coast - -	5	51
Isle of Man, South side -	10	20
Ives, (St.) England; r. 24 ft. -	5	15
Jackson (Port) New Holland	8	15
Jago (Isle) Africa - -	7	45
Janeiro, (Rio) Brazil -	4	30
John's, (St.) Newfoundland -	6	0
Jean-de Luz, (St.) France -	6	0
Jersey Island; r. 23 ft. -	6	0

Table XXVIII. High Water.

	H.	M.
Juan, (Cape St.) America	4	0
Julian, (Port St.) Patagonia	4	45
Jutland, (along the Coast of,)	12	0
Karakahoo Bay, Sandwich I.	3	45
Kedgerea, India	11	30
Kenmare River, Ireland	3	45
Kennebeck, America; *r.* 9 *ft.*	10	45
Kentish Knock, off the Thames,	11	30
Kilduyn, Lapland	7	30
Killybegs, Ireland	6	45
Kingroad, near Bristol; *r.* 42 *ft.*	6	48
King's Channel or Swin; *r.* 16 *ft.*	12	0
Kinghorn, Scotland	2	30
Kinsale, Ireland	5	15
Kinnaird's Head, Scotland	12	0
Kirkaldy, Scotland	2	15
Kirkcudbright, Scotland	11	15
Kirkduyn, Holland, near the Texel; *r.* 12 *ft.*	7	30
Komaroo, (Cape) N. Zealand	9	30
Labradore Harbour, (Straits of Belleisle)	11	30
Lambaness, N. end of Shetland; *r.* 5 *ft.*	9	30
Lancedora, Canaries	12	45
Lancaster, England	11	15
Land's End of England	4	30
Leith Pier, Scotland; *r.* 15 *ft.*	2	20
Lerwick in Shetland	1	30
Lewis and Harris, (along the Shores of,) Scotland; *r.* 11 *ft.*	6	0
Lewises (Butt of the)	6	45
Lieh	12	0
Limekilns, on the Frith of Forth	3	30
Limerick, Ireland; *r.* 16 *ft.*	6	30
Lisbon, Portugal	2	15
Liverpool, (entr. of the Harbour;) *r.* 26 *ft.*	10	30
Lizard Point, on shore, England,	5	0
Lochdon	4	30
Lochlairne, Scotland	9	45
Loch Swilly, Ireland	7	30
Lochshill, Holland	6	0
Loire River, entr. France	3	0
London; *r.* 19 *ft.*	2	46
Londonderry, Ireland	6	0
Long Island, America	3	0
Long Sand Head, Riv. Thames,	11	30
Longships, England	4	30
Loop Head, Ireland	4	30
Louisburg, America	7	15
Lowestoff, on shore, England; *r.* 7 *ft.*	9	0
Lowestoff Road	9	10
Lowestoff and Orfordness (offing between)	11	15
Lundy Island, Bristol Channel; *r.* 30 *ft.*	5	45
Lynn Regis, England	7	5
Lymington, England	11	15
Lynn Deeps, England; *r.* 20 *ft.*	6	0
Machias, America; *r.* 12 *ft.*	11	0
Madeira Island, *r.* 7 *ft.*	12	4
Madre de Dios, Pacific Ocean	2	30
Maes and Maisland Sluice, Holland	3	0
Magnus's Sound, (St.) Orkney; *r.* 8 *ft.*	8	15
Malacca Road, India	10	30
Maloes, (St.) France; *r.* 45 *ft.*	6	30
Marble Head, America; *r.* 12 *ft.*	11	30
Margate Roads, Engl. *r.* 16 *ft.*	11	45
Martha's Vineyard, America	9	0
Martinique Island, West Indies	7	30
Mary's, (St.) Scilly	4	40
Mauritius, (Isles)	12	30
May, (Cape) America	8	45
May Isle, Scotland	1	30
Merqui, India; *r.* 15 *ft.*	12	0
Miquelon, Newfoundland; *r.* 7 *ft.*	9	0
Milford Haven; *r.* 36 *ft.*	6	0
Minehead, England; *r*, 36 *ft.*	6	0
Mizen Head, Ireland	3	0
Monastry Island, White Sea; *r.* 6 *ft.*	7	30
Montrose, Scotland	1	30
Monterry, Pacific Ocean	7	30
Morlaix, France; *r.* 30 *ft*	6	0
Morocco, (along the Coast of,)	2	15
Mount Desert, Massachusetts; *r.* 12 *ft.*	11	0
Mount's Bay, England; *r.* 19 *ft.*	4	30
Nangasachi, Pacific Ocean	6	0
Nantucket Shoals, America; *r.* 5½ *ft.*	10	30
Nantucket, America; *r.* 6 *ft.*	12	3
Nantz, France	4	0
Nantz (before the River of)	3	0
Nassau, New Providence	7	30
Natal River, Africa; *r.* 12 *ft.*	10	0
Naze, Norway	11	15
Naze of Essex, England	11	20
Needles I. of Wight; *r.* 9 *ft.*	8	56
Nevyn Bay, Wales; *r.* 20 *ft.*	8	45
Newcastle-upon-Tyne	4	0
New Bedford, America; *r.* 5 *ft.*	7	37
Newburgh, Scotland	12	30
Newburyport, America; *r.* 10 *ft.*	11	15
Newhaven, England; *r.* 20 *ft.*	10	16
Newhaven, America; *r.* 8 *ft.*	11	0
New London, America; *r.* 5 *ft.*	8	54
Newenham, (Cape) Pac. Ocean	12	0
Newport, Flanders	12	0
Newport, Wales; *r.* 24 *ft.*	6	45
Newry, Ireland	12	0
New York, America; *r.* 5 *ft.*	8	54
New Zealand, (Bays, &c.) Pacific Ocean; *r.* 7½ *ft.*	8	0
Nicholas (before St.)	6	45
Noddy Harbour, Newfoundland	5	15
Nootka Sound, America; *r.* 9 *ft.*	12	20
Nore, R. Thames; *r.* 14 *ft.*	12	15
Norfolk Sound, North Holland	1	0
Normandy and Picardy (Coast-of)	10	30
North Berwick, Scotland	1	30

Names of Places.	Lat. D. M. S.	Lat. D. M. S.	Names of Places.	Lat. D. M. S.	Long. D. M. S.
Sandwich { From	17 29 0S	168 20 30E.	Port Refuge ..	18 18 30S.	173 56 0W
Island } to	17 53 0	168 45 25	Savage Island	19 2 15	169 30 30
Traitor's Head ..	18 43 30	169 20 30	Agyoau ...	19 39 15	174 43 0
Small Island off....	18 41 0	169 26 0	Hapae, North Point	19 41 0	174 37 20
Inmer	19 16 0	169 46 0	Mattafoa ...	19 44 30	174 47 0
Tanno Island { From	19 16 30	169 21 0	Turtle Island	19 48 45	177 57 0
to	19 38 30	169 43 0	Annamooka ...	20 15 2	174 51 55
Port Resolution ..	19 32 24	169 43 0	Tongotaboo, Bander-		
Inanama	19 31 0	170 21 0	main Road	21 4 15	174 56 24
Enatum	20 10 0	170 4 0	Annamoke Ette ...	20 17 45	174 32 30
New Caledonia.			Commango Ette ...	20 18 20	174 28 0
Balleabea Island ...	20 7 0	164 22 0	Commango ...	20 19 20	174 26 0
Pudyoua Obs. ..	20 18 10	164 41 12	Tonamai	20 28 0	174 31 30
Cape Colnet ...	20 30 0	164 56 0	Tellefageo	20 31 15	174 29 15
C. Coronation	22 5 0	167 8 0	Morotoi	21 9 0	156 44 0
Queen Charlotte's			Eaoowe	21 20 30	174 34 0
Foreland	22 15 0	167 12 4	Pylstaart's Island ...	22 23 30	174 48 0
Isle of Pines ..	22 38 0	167 38 0	Oheteroa ...	22 27 0	150 47 0
Botany I. anch. off..	22 26 40	167 16 45	Toobovai ...	23 25 0	129 40 30
Norfolk Island	29 1 45	168 10 0	Palmerston Island ..	18 0 1	162 57 0
New Zealand.			Whylotack	18 51 40	159 39 45
Three Kings	34 12 0	172 12 0	Harvey's Island ...	19 16 0	158 48 0
Cape Maria ...	34 30 0	172 42 0	Owhyhe	19 28 12	156 26 0
North Cape ...	34 27 0	173 5 0	Wateoo Island	20 1 30	158 14 30
Mount Camel	34 51 0	173 10 0	Mangeea Island ...	21 56 45	185 3 0
Cape Brent ...	35 10 30	174 40 0	*Society Islands.*		
Cape Colville ..	36 26 0	175 33 0	Scilly Island ...	16 28 0	156 22 0
Mercury Bay ..	36 47 0	175 56 0	Ohamaneno ...	16 45 32	151 39 40
Cape Runaway ..	37 32 0	178 12 0	Howe's I. ..7..	16 46 30	154 6 40
East Cape	37 42 30	179 0 0	Marua Island ...	16 25 40	152 32 40
Mount Edgecumbe .	37 59 0	166 53 0	Bolabola Island .	16 32 30	151 51 53
Tolaga Bay ...	38 22 24	179 13 0	Ulietea ...	16 32 30	152 57 0
Poverty Bay ..	38 42 0	178 24 0	Huaheine	16 43 0	150 52 0
Albatross Point ...	38 4 0	175 18 0	Owharre Harbour ..	16 44 45	151 9 40
Cape Table ...	39 7 0	178 24 0	Lord Howe's I. ...	16 46 0	155 25 0
Mount Edgecumb ..	39 16 0	174 45 0	D. of York I.	17 28 0	151 14 0
Table Head	39 17 0	177 59 37	Emio	17 30 0	149 54 0
Shambles ...	39 20 0	178 20 45	Otaheite, Obs.	19 29 15	149 32 30
Portland	39 25 0	178 12 0	Point Venus ...	17 29 20	149 36 45
Cape Kidnappers...	39 43 0	177 36 0	Oaitepeha Bay	17 46 30	149 14 24
Cape Turnagain....	40 34 0	177 5 0	Osnaburg ...	17 48 0	148 10 0
C. Stephens (I. off)	40 37 0	174 54 0	Palliser Island	15 38 15	146 30 15
Banks's Island	43 32 0	173 30 0	Chain Island ..	17 25 0	145 38 53
Cape Saunders	45 44 0	167 48 0	Oheteroa	22 36 36	150 48 45
South Cape	47 19 0	167 48 0	Toobouai ...	23 25 0	149 20 30
Knight's Island ...	48 15 0	166 44 0	Taookaa Island	14 30 30	145 9 30
Solander's Island ...	46 31 0	167 11 0	Adventure Island ..	17 6 20	144 17 45
West Cape	45 54 0	166 43 0	Furneaux Island ...	17 11 0	143 6 40
Dusky Bay ..	45 47 30	166 18 9	Resolution Island ..	17 23 15	141 45 0
Cape Farewell	40 33 0	174 0 0	Bird Island ..	17 48 0	143 35 0
Q. Charlotte's Ent..	41 0 0	175 15 0	Groups, S. Emost. .	18 12 0	142 42 0
— Sound ...	41 6 0	174 18 30	Bow Island, E. end.	18 23 0	141 12 0
Cape Campbell	41 44 0	176 15 0	Prince Henry's I. ..	19 0 0	141 6 0
Cape Palliser ..	41 34 0	176 7 0	Cumberland Island .	19 18 0	148 36 0
Point Rodney	36 15 0	175 7 0	Gloucester Island ..	19 11 0	140 4 0
Two Sisters ...	43 41 0	177 11 0	Q. Charlotte's I. ..	19 18 0	138 4 0
Skirmish Bay	43 49 0	176 35 0	Egmont Island	19 20 0	138 30 0
Cape Young	43 48 0	176 58 0W	Whitsunday Island..	19 26 0	137 56 0
Friendly Isles.			Lagoon Island	18 47 0	139 28 0
D. of York's I. ...	8 29 0	172 22 0	Thrumb Cap ..	18 35 0	139 48 0
Wallis's Island ...	13 18 0	178 30 0	Osnaburg Island ..	17 51 0	147 30 0
Keppel's Island	15 53 0	176 18 0	Blight Lagoon I. ..	21 38 0	140 37 0
Boscawen's Island ..	15 50 0	176 15 0	Pitcairn's Island ..	25 2 0	133 30 0

	H.	M.
Seal Iſles, Bay of Fundy; r. 12 ft.	8	45
Seaton Sluice, Northumberland; r. 10 ft.	2	45
Seine, (within the) France	9	0
Selburgh, (before)	9	0
Selſey Bill, England; r. 16 ft.	9	36
Selſey Harbour, England; r. 15 ft.	11	15
Seven Cliffs, England	9	50
Seven Iſlands, Lapland; r. 15 ft.	9	0
Shetland, S. end; r. 6 ft.	10	30
Shiant Iſles, Scotland; r. 10 ft.	8	0
Shields, (N. and S.) England; r. 14 ft.	3	0
Shipwaſh, King's Channel	12	0
Shoreham, England; r. 16 ft.	9	20
Sierra Leone, Guinea	8	15
Simon's Bay, Cape of Good Hope	5	55
Simon's Bay, Africa; r. 3 ft.	3	30
Shellocks, Weſt of Ireland	3	0
Skerries, near Holyhead	9	45
Skerries, North of Ireland; r. 11 ft.	4	45
Sky Iſland, Scotland	6	0
Sligo, Ireland	6	45
Slyne-head, Ireland	5	15
Smalls, Wales	5	50
Smith's Knowl, North Sea	12	0
Solebay, England; r. 7 ft.	10	30
Somme River, France	10	30
South Foreland, England	11	6
Southampton, England; r. 18 ft.	11	45
Shannon River, (ent.) Ireland; r. 12 ft.	4	30
Sheerneſs, England; r. 15 ft	12	0
Sheepſcut, America; r. 9 ft.	10	45
Southwould, England	9	0
Spain, North Coaſt of	3	0
Spithead, near Portſmouth	9	30
Spurn Point, England; r. 20 ft.	5	15
Stadtland, Norway	12	0
Stanway	6	45
Staples, Scotland; r. 15 ft.	2	30
Start-Point, England; r. 20 ft.	5	55
Stockton, England	4	30
Stonehaven, Scotland	1	0
Stromneſs, Orkney	10	30
Sunderland, England; r. 12 ft.	3	0
Sunborough Head, Shetland	4	0
Sunbury, America	9	30
Surat, India	4	20
Swanſea, Wales; r. 30 ft.	6	0
Sweetnoſe, Lapland; r. 16 ft.	12	0
Swin. See King's Channel.		
Sychelles Iſland, India	5	30
Tanna, (New Hebrides) Pacific Ocean	3	0
Tarbetneſs, Scotland	11	30
Tarpaulin Cove, Maſſachuſetts; r. 5 ft.	9	52
Tavy Iſland, India; r. 15 ft.	9	0
Tay-bar, Scotland	2	0
Tees, (River's Mouth) r. 14 ft.	3	30
Telling Cape, Ireland	6	0
Tervere, or Compveer, Holland	1	30
Texel-road, r. 6 ft.	7	45
Three Iſlands, Lapland; r. 17 ft.	2	15
Tinmouth-bar, England; r. 13 ft.	3	0
Tolegă Bay, New Zealand, Pacific Ocean	6	0
Tongataboo, Pacific Ocean	6	50
Topſham, England; r. 10 ft.	7	5
Torbay, (Berry-head) England; r. 20 ft.	6	0
Trincomale, Ceylon Iſland; r. 3 ft.	6	0
Townſhend, Maſſachuſetts; r. 9 ft.	10	45
Tudwal's Road, (St.) Wales; r. 20 ft.	8	0
Tuſkar Rock, Ireland	6	30
Typa Road, China, r. 6 ft.	10	0
Ulitea, Pacific Ocean	11	36
Uſe and Villain River, France	3	0
Uſhant, (within) Fr. r. 20 ft.	3	45
Vallery en Cau, (St.) France; r. 18 ft.	11	15
Vannes, France	3	30
Venice, Italy	9	0
Verde, (Cape) Atlantic	7	45
Vincent Cape, (St.)	2	15
Virgin, (Cape) Patagonia	12	0
Vlie Paſſage, Holland	9	0
Wales, (Sea of) and Severn	1	30
Wardhouſe, or Wardhuys	4	0
Wallet, near the Swin	11	15
Waterford, Ireland; r. 13 ft.	5	30
Weems, Scotland	2	0
Weeſer, firſt Buoy	12	0
Weillings, Flanders	1	30
Wells, Norfolk	6	0
Wexford Harbour, Ireland	7	30
Weymouth, England; r. 7 ft.	6	15
Whitby, England; r. 13 ft.	3	45
Whitehaven, England	11	15
Wick, Scotland	9	15
Wicklow, Ireland	9	0
Wight, (Iſle of) Weſt end. See Needles.		
Wilmington, America	11	0
Winchelſea, England	12	45
Winterton, England; r. 10 ft.	8	15
Wiſbeach, England	7	30
Woodbridge-bar, England; r. 14 ft.	11	30
Woolwich, on the Thames; r. 18 ft.	2	15
Wrath, (Cape) Scotland	8	15
Yarmouth Roads, England; r. 8 ft.	8	45
Yarmouth Sands, (back of)	10	30
Yarmouth, Iſle of Wight; r. 12 ft.	9	30
Youghall to Dundedy-Head, Ireland; r. 11 ft.	4	3
Zuder Zee, Holland	1	30
Zuric Zee, Holland	3	0

FINIS.

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ERRATA.

Page	Line	For	Read
13	36	d q	d g
16	35	1 50	1 56
22	42	4104	410.4
36	bot. of Fig.	205.5	203.5
39	4	235	225
61	23	2,60873	2.60853
69	Cut dist.	58,8	158.8
77	32	X Long. 1192	1200
	34	X Lat. 777	779
78	1	Dep. 865	870.9
82	8	X Long. 8° 11′	6° 59′
91	29	7.01586	637 7,91586
94	26	59,1	59
95	3	0.09639	0.09689
96	15	Lon. left 10° 15′	10° 16′
97	19	271,8	721.8
98	Cut dist.	1025	1024
104	18	1.96251	1.92651
123	3	10 h. 30 m.	11 h. 30m.
129	20	October	August
131	28	22d. 6h.	2d. 6h.
139	31	from the fun	from the fum
175	13	Dep. 32,8	32,3
182	22	1159	1059
183	39	6.28	6.26
	41	7.47	7 45
184	21	51	1.53
	29	18.3	18,8
	33	96.3	95.8
	57	2926	2928
185	22	1,46	1.41
186	22	25	19
	22	2.11	2.0
	29	81.21	79.0
	29	25	20
193	40	1.35	1.33
195	31	37.28	31.26
196	33	51.5	31.5
201	bot. line	96355	96351
204	29	24165	24615
208	3	19.41	19.40
	9	19 41	19.40
	30	20m 7.69305	17m 7.69335
210	27	18 h. 40 m.	18 h. 20 m.
215	45	244 22 45	244 12 45
226	17	1 20 16	1 28 16
	18	1 32 51	1 31 57
231	11	31 13	31 30
	32	45	40 55
	35	15 47	15 57
232	21	Sun's	Moon's
	23	23 40 7	23 44 7
	26	58 48	58 46
	40	23 40 7	23 48 7
233	26	25 45	25 8 45
	49	20 57 47	20 57 04
	57	7′ 30″ 25″	7′ 30″ and
234	42	30 18 30	31 18 30
	55	9.5691	0.5691
	57	3117	3114
	59	28,39	18 39
	61	5072	5074
235	17	half their fum	take half thei
239	7	57′ 30″	51 30
242	35	7 14 38	7 14 30
245	2	18 8 30	8 3 30
253	7	50 45	40 45
254	19	14 96	14 97
	28	123 43	123 47
260	10	W. N. W. N.	W. N. W.
	25	N. b W.	N. b W. ½
	26	N. ½ E. ½ W.	N. ¼ E.
262	30	Table 30	Table 21
267	44	A pully	Putty
288	44	a fferent	different
	45	nchor	anchor
292	28	as in the	as on the
311	15	Cornwall	Cape Cornw


NORTHERN
VI
VII
VIII
IX
X
XI
XII
XIII
XIV
XV
XVI
XVII
XVIII
Betelgues
Bellatrix
Procyon
Foot of Pollux
Knee of Pollux
Acubens
Pollux
Castor
Tauri
Capella
Regulus
Lower Pointer
Upper Pointer
Pole Star
Alioth
Benetnach
Alderamin
Arcturus
Mirach
Alphacca
Rastaben
Lyra
Ras Algathi
Ras Alague

Dossiou del.